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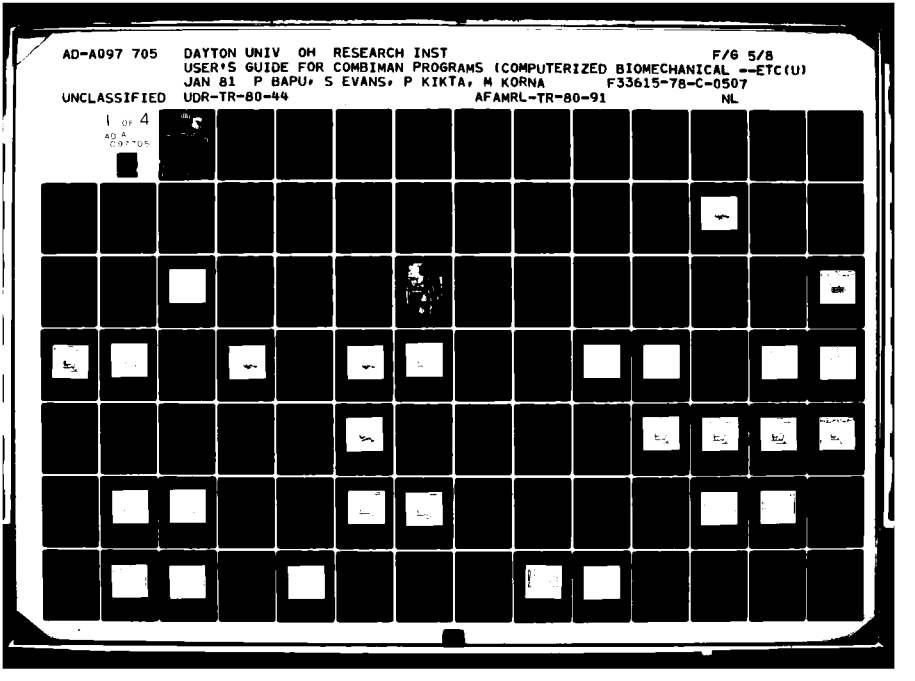

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USER'S GUIDE FOR COMBIMAN PROGRAMS (COMputerized Biomechanical MAN-Model)

Version 4

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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

CHARLES BATES, JR.
Chief
Human Engineering Division
Air Force Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This User's Guide describes the operational procedures for using the AFAMRL COMBIMAN (COMputerized BIomechanical MAN-Model) programs. The Guide is based on the programs as of 29 February 1980. The Guide includes an introduction to the man-model and the conventions used to develop and analyze crew stations. It also deals with the operation of the programs which make up the COMBIMAN system. These programs include the interactive graphics program CBM04, and

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and the three key file creation/modification programs CBMAM, CBMCM, and CBMVM, which maintains the Data Bases of anthropometric surveys, crew station configurations, and visibility contour definitions respectively. It also contains a complete description of the use of CBMOFF, the off-line plot program.

The guide to the operation of the four main programs includes descriptions of the processing available with each program, definitions and examples of all input and output data formats used, procedures to follow to load the programs and specify processing for each, and explanations of all diagnostic messages generated by the programs.

SUMMARY

This User's Guide describes the operational procedures for using the AFAMRL COMBIMAN (COMputerized BIomechanical MAN-model) programs. The Guide is based on the programs as of 29 February 1980. The Guide includes an introduction to the man-model and the conventions used to develop and analyze crew stations. It also deals with the operation of the programs which make up the COMBIMAN system. These programs include the interactive graphics program CBM04, and the three key file creation/modification programs CBMAM, CBMCM, and CBMVM, which maintains the Data Bases of anthropometric surveys, crew station configurations, and visibility contour definitions respectively. It also contains a complete description of the use of CBMOFF, the off-line plot program.

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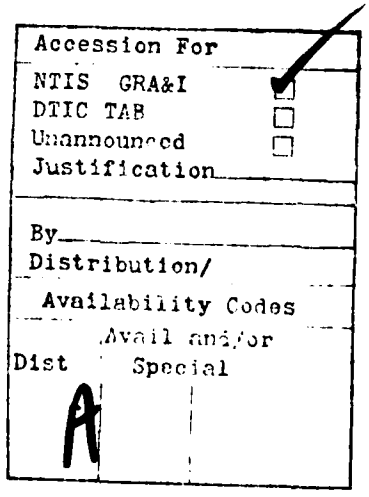

PREFACE

This work was performed under USAF Contract F33615-78-C-0507 entitled Biomechanics of Cockpit Evaluation. The government work unit number for this contract is 71840824. The contract monitor and technical advisor is Dr. Joe W. McDaniel of the Workload and Ergonomics Branch of the Air Force Aerospace Medical Research Laboratory. The development of the programs to which this User's Guide refers was performed by the University of Dayton Research Institute (UDRI). The UDRI Technical Report number for this Guide is UDR-TR-80-44.

The purpose of this report is to provide a detailed guide to the use of the key computer programs of the AFAMRL COMBIMAN program. It is not intended to document the theoretical approach taken in developing any of the computer programs. The manipulation of the model and crew station is straightforward and the information contained in Section 2 will enable a noncomputer person to run the interactive graphics program CBM04. Because of the technical nature of the plot program described in Section 3, and the database maintenance programs described in Sections 4, 5, and 6, some computer skills would be required of the person assigned to interpreting and using these programs. Since all the programs are considered relevant to the COMBIMAN effort, they are all included in this guide for completeness. The description of the man-model and crew station in the introduction is presented as general background material needed to efficiently use the programs. The link-system described in the introduction is based on research originally performed by W. T. Dempster of the University of Michigan. Dr. K. W. Kennedy of AFAMRL/HEG contributed to the definition of the Anthropometric Data Base and provided significant improvements to the Dempster man-model link system.

The authors would like to acknowledge the assistance and the technical support provided by Mr. Charles Clauser of the Workload and Ergonomics Branch of the AFAMRL. In Addition, the authors would like to thank Ms. Charlene Thompson of UDRI for her patience while typing this User's Guide.

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SECTION 1
INTRODUCTION

During the design and analysis phases of crew station development, it is essential to assess the inadequacies and dangers of the crew station environment with respect to the human operator. The conventional method for accomplishing this has been to build mock-ups and use an undetermined number of "representative" test pilots to evaluate the work environment and control placement. The mock-ups tend to be costly and time consuming to build, as well as somewhat inflexible during testing. The sample size of the "representative" pilots depends on pilot availability and the whims of the designers.

The COMputerized BIomechanical MAN-model (COMBIMAN) system of programs has been developed to assist in the design and analysis phases of crew station development. It has been designed to serve as an interactive-computer-graphics-assisted engineering tool to represent geometric and physical properties of a person at a crew station. It has applications in evaluating conceptual or existing crew stations. The COMBIMAN model is a three-dimensional man-model and can be viewed from any plane or angle. Since the man-model and crew station exist only on the Cathode Ray Tube (CRT) and in computer memory, no significant amount of time or materials are invested in making modifications. Alternative designs may be thoroughly evaluated and permanently recorded by a pictorial plot or a tabular printout of the crew station data and man-model (McDaniel, July 1974). Because of these capabilities, the COMBIMAN should reduce the need for building mock-ups, as the designer can construct a crew station in three dimensions on a CRT and can assess interactions using man-models of various body sizes and proportions.

1.1 MAN-MODEL GENERATION

The man-model used in COMBIMAN is based on a 35 link-skeletal system. Each of these links connects major points of rotation of the body segments as shown in Figure 1. The lengths of the links of the skeletal system can be modified by the user. Since the segment lengths or link-lengths are generally internal dimensions and difficult to measure on live subjects, the link lengths are derived from 12 readily measurable anthropometric surface dimensions. The sets of anthropometric variables available to the user are highly correlated to body segment mass or length. A more detailed description of these variables will be given in Section 3. Section 2 will describe the ways the user can change the proportions of the model by specifying new values for the surface dimensions.

There are three stages in generating the man-model. In the first stage, the link system is defined and generated using data available from the anthropometric data base and/or data supplied by the user (see Figure 1). The other two stages use data supplied in stage one and data stored in the computer. The second stage places enfleshment ellipsoids about the link system joints as shown in Figure 2. In the third stage, the ellipses are connected with tangent lines to define the contour of the model (see Figure 3). The user does not see these stages of model development; only the completed model is displayed.

The primary viewing planes for COMBIMAN are the X-Z (side), the X-Y (top) and the Y-Z (front). The man-model need not be parallel to any one of these 3 orthogonal planes; it can be rotated by an angle with respect to these planes. Figures 1, 2, and 3 show COMBIMAN in the X-Z plane (side view).

1.2 CREW STATION DESIGN

Crew stations to be designed and evaluated using the COMBIMAN system consist of panels and controls. A crew station may have up to 250 planar panels with 3 to 6 vertices and 150 controls

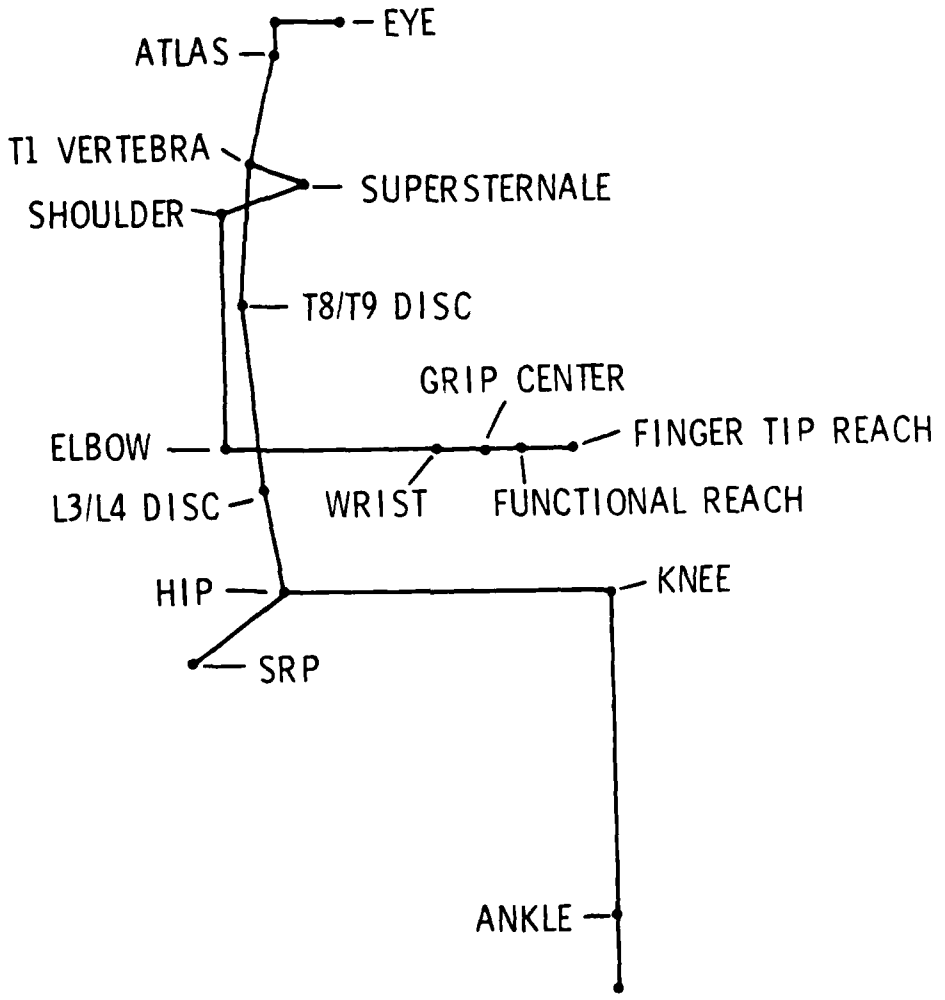


Figure 1. COMBIMAN Link System - Side View.

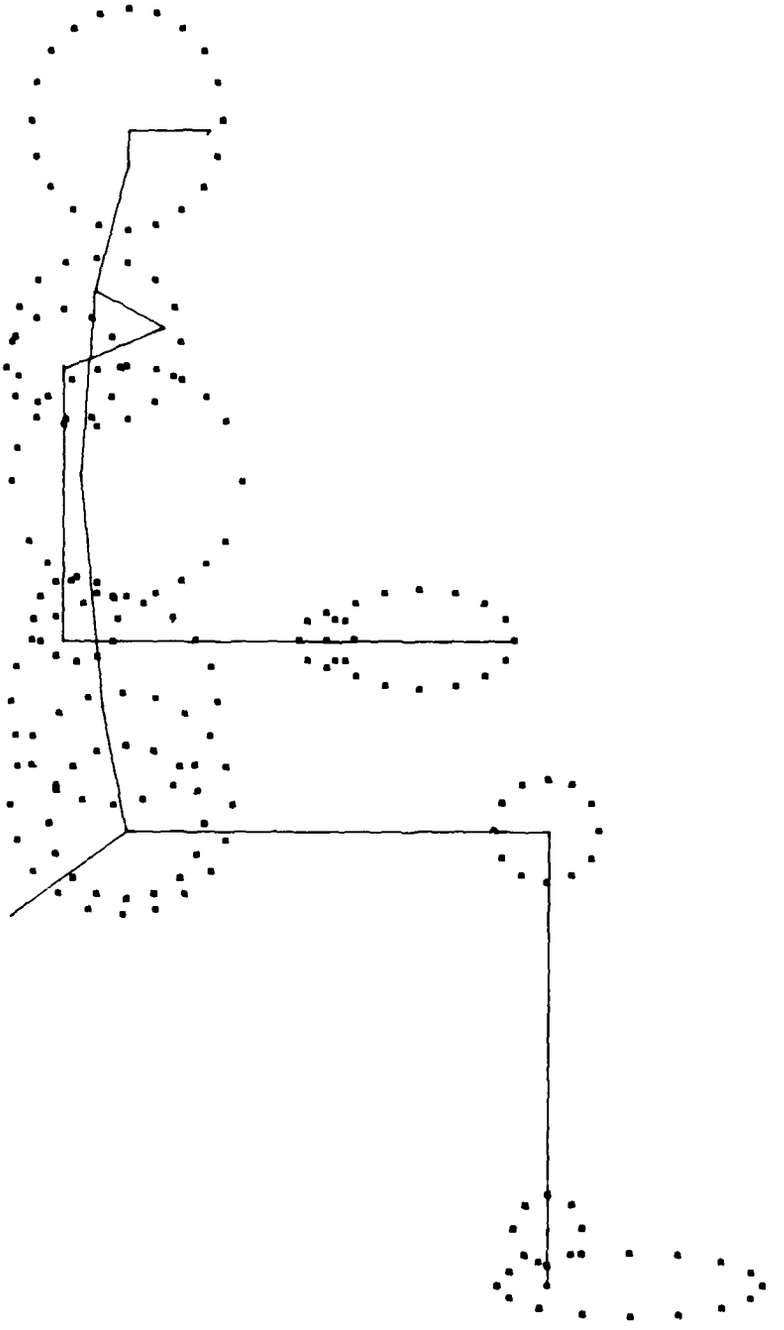


Figure 2. COMBIMAN Link System with Enfleshment Ellipses.

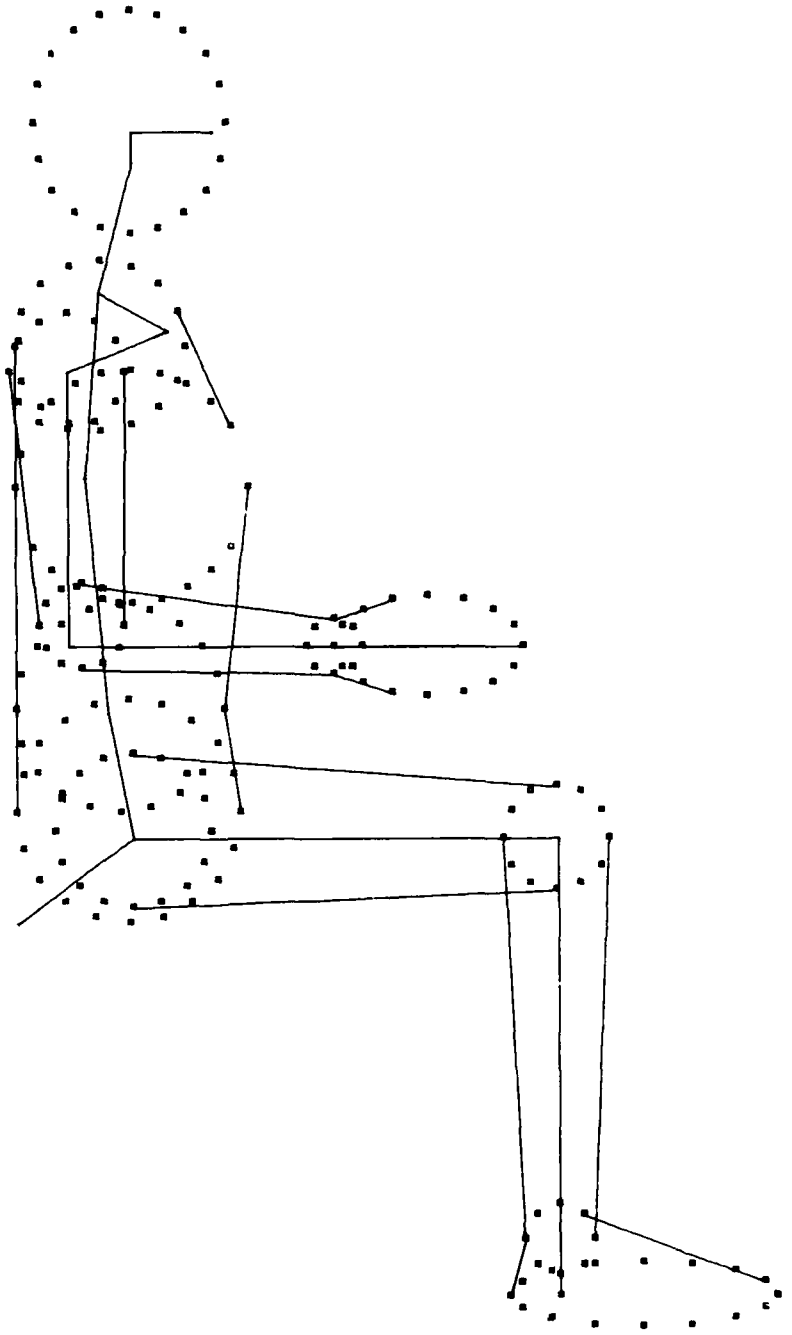


Figure 3. Enfleshed COMBIMAN with Tangent Lines.

which may or may not be located on the defined panels. Although the crew stations used in COMBIMAN are usually aircraft crew stations, it is possible to construct and display any workspace requiring interaction by a seated operator. This would include automobile instrument panels, industrial configurations, and control panels for other types of vehicles.

Two methods are used to generate and display crew stations. The designer can either use an existing or conceptual configuration, or can construct a new one on the Cathode Ray Tube (CRT) using the available interactive graphic options. In the first method, panels and controls for existing or conceptual configurations, are coded onto computer cards, or magnetic tape, or direct access disk, and are entered into the Crew Station Data Base. These data are accessible to the user through the interactive graphics program. In the second method, the user can design crew stations at the CRT, using alphanumeric keyboard and the program function keys, following the basic series of steps similar to those used on a drawing board.

A crew station entered into the program exists in three dimensions and the man-model can interact with it. Since the CRT has only two dimensions, the 3-D man-model and crew station are projected onto the screen in the orientation the user selects. The display can then be rotated within the display area to suit the designers' needs. An example of the display with a rotated and magnified model and crew station are shown in Figure 4.

1.3 EVALUATION TECHNIQUES

A number of evaluation techniques have been implemented into the COMBIMAN system. Primarily, they are designed to allow the user to vary the proportions of the man-model to suit a particular situation or problem, and to position the model within the crew station to assess human performance and to aid in placement of controls and panels.

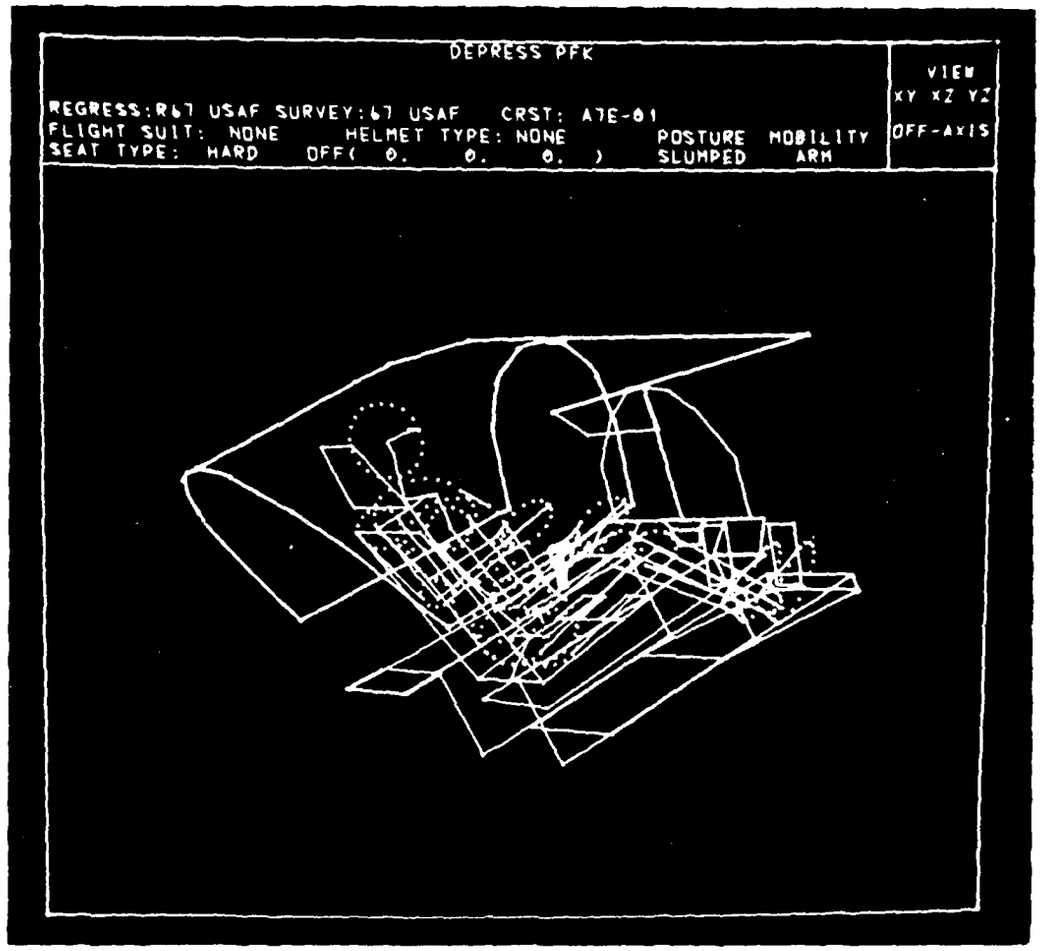


Figure 4. COMBIMAN CRT Display with Man-Model and Simplified Crew Station Rotated OFF-AXIS.

In order to display the man-model on the CRT, COMBIMAN uses information from on-line disk files and from user supplied data on anthropometric surface dimensions. The ability to make use of user supplied anthropometric data permits the construction of man-models of variable proportions suitable to the particular needs of the user. To define the man-model, CBM04 (COMBIMAN program Version 4) requires values for the twelve anthropometric variables to generate the 35 internal link lengths. The user can either supply values for all 12 variables or supply values for one mass related and one length related variable and let the program compute the other 10 variables using multiple regression equations. The user supplied data may be (a) direct measures obtained from specific subjects; or (b) percentile values chosen from the COMBIMAN Anthropometric Data Base. The latter option is generally the most useful, as it limits the range of values for user supplied dimensions and eliminates unrealistic combinations of dimensions.

The man-model can be positioned in a crew station by directly entering sets of rotational angles used to position the links of the model, or with the PERFORM REACH ANALYSIS function (see Paragraph 2.2.11) by specifying a point on the display. The later method applies to reach involving the arms and incorporates automatic restrictions to mobility. The user may also initialize the man-model in the standard anthropometric seated measuring posture (ERECT POSTURE), the SLUMPED POSTURE, which is an erect posture positioned in a 13° seat back angle and 6° seat pan angle, or a third posture (PRGM'D POSTURE) defined by the user.

Other information available to the user includes hard copy plots of the display, printed output showing the three dimensional real world coordinates of the man-model and of the panels of the crew station, and visibility plots, which give the user information on the visual field of the crew station based on the eye position of the model.

1.4 THE COMBIMAN PROGRAMS

The COMBIMAN system is divided into five programs, the main program being the interactive graphics program CBM04, which allows the user to generate a variable size man-model and then assesses interaction with new or existing crew stations. Before the user can define the proportions of the man-model, or call up crew stations and visibility contours for evaluation, the files which store the anthropometric, crew station, and visibility member data must be created. This is done using three specialized file creation/modification programs, each dealing with a particular type of data set: anthropometric, crew station, or visibility member. Similar sets of commands are used by each program to initialize the file, add data, delete data, write existing data groups to the printer, or to punch data groups to cards. The data flow of the COMBIMAN program is shown in Figure 5. Figure 5 also shows a fourth file, the initialization data set, which is used in constructing the man-model and cannot be modified by the user.

The following sections will explain the operation of four of the key programs of the COMBIMAN system, including the interactive graphics program CBM04, and three of the file manipulation programs which maintain the data files used as input to CBM04. The manipulation of the man-model and crew station using the interactive graphics program CBM04 is straightforward. Sections 1 and 2 of this guide will provide a designer not skilled in computer programming with sufficient information to use the interactive program CBM04. The technical nature of the data and programs described in Sections 3, 4, 5, and 6 requires some computer skills to interpret and use these Data Base maintenance programs.

Section 2 describes the use of the function keys which may be activated by the user in program CBM04 to manipulate the man-model and to design and to evaluate crew stations. This section includes examples of the optional as well as the standard output formats supplied by the program, and lists the possible error or information messages generated by the program.

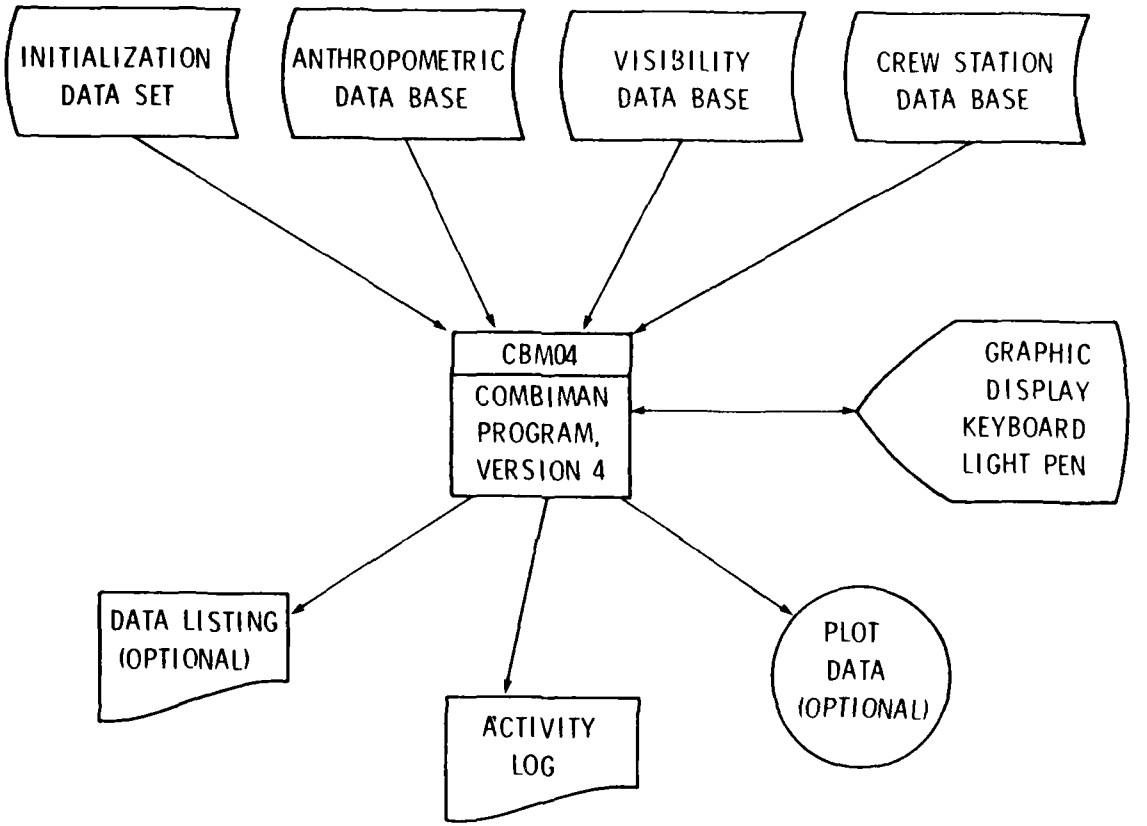
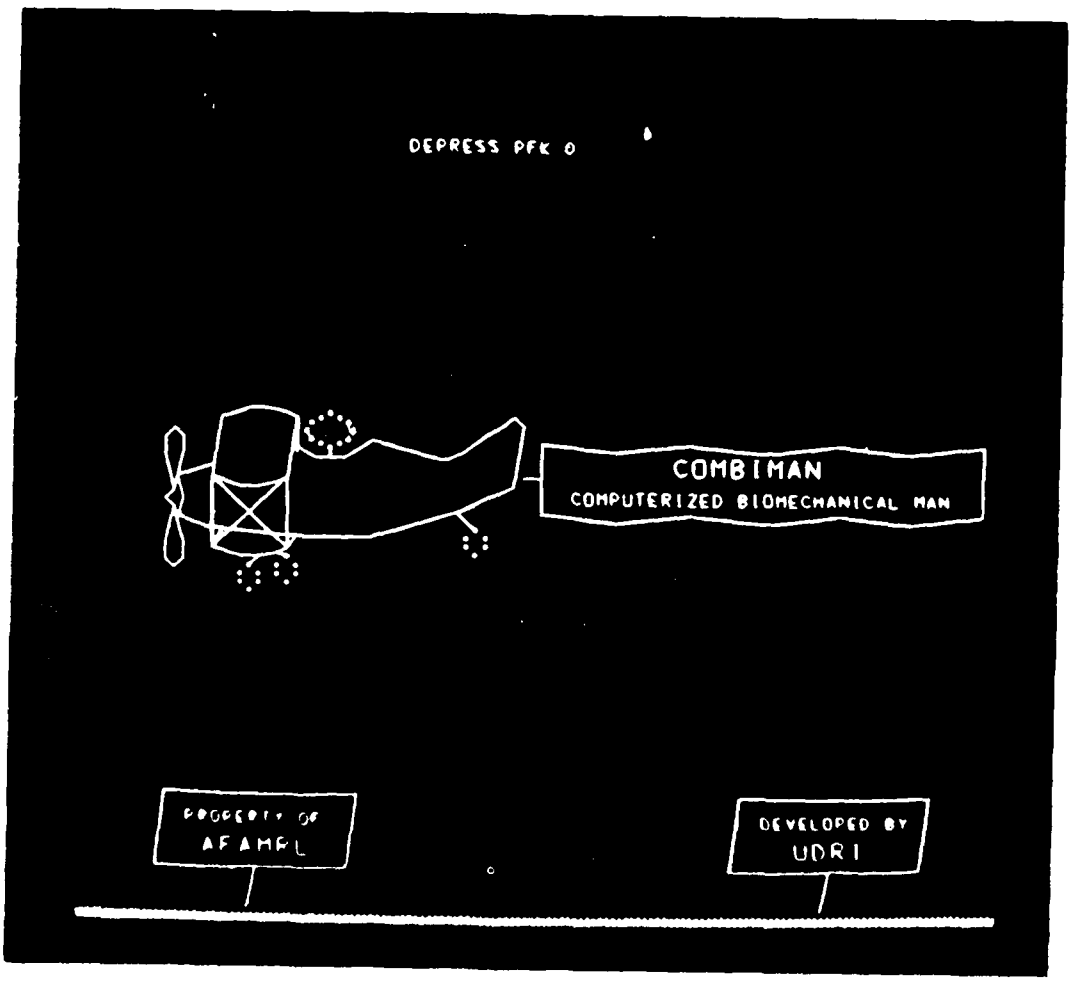


Figure 5. Data Flow in the COMBIMAN Program.

Section 3 describes the COMBIMAN off-line plotting program, CBMOFF. This program uses data generated by CBM04 to produce plots of variable size, color, and content from three-dimensional coordinate data. Input formats, plotting options, and program output are explained in this section.

The program which creates and maintains the data base of Anthropometric surveys, CBMAM, is documented in Section 4. The types of data which may be stored, the sources for such data, the input data formats, sample output formats, and message formats are discussed. The uses of, and formats for, the commands or functions which manipulate the file are also described.

The program which creates and maintains the data base of geometric descriptions of crew station configurations, CBMCM, is documented in Section 5. The program which creates and maintains the data base of geometric descriptions of crew stations for visibility plots, CBMVM, is documented in Section 6. Data sources and input, output, and message formats are described for both programs. These sections also contain examples of Job Control cards to run the programs.



BEGINNING OF COMBIMAN PROGRAM.

SECTION 2

THE COMBIMAN INTERACTIVE GRAPHICS PROGRAM VERSION 4, - CBM04

At the heart of the COMBIMAN system is the fourth version of the COMBIMAN interactive graphics program CBM04. The program uses an IBM 2250-3 Display Unit for the design and analysis of crew stations. The user at the display device controls the course of execution of program CBM04 using a Program Function Keyboard. Functions of the program may be executed by depressing lighted Program Function Keys (PFK). This section describes the functions available to the COMBIMAN user, shows the output that the functions may generate, and traces through suggested execution sequences for generating the man-model, and retrieving a crew station.

2.1 INTRODUCTION

The graphics program CBM04 enables the designer to bring together the information on anthropometry and crew stations stored on disk (see Sections 4 and 5) and combine them with the interactive qualities of the Cathode Ray Tube (CRT). Doing this, one can evaluate real-life conditions, or establish design criteria for new situations in a fraction of the time it would take using conventional methods.

For design and evaluation sequences, the 12-inch square CRT screen is partitioned into Prompting, Information, and Display areas (see Figure 6). The Prompting Area displays messages indicating what the user should do next. This area is also used to accept replies via the alphanumeric keyboard when requested. The Information Area displays the anthropometric survey name, the crew station, and the program function currently executing. The 10-inch square Display Area is used to display the man-model and crew station.

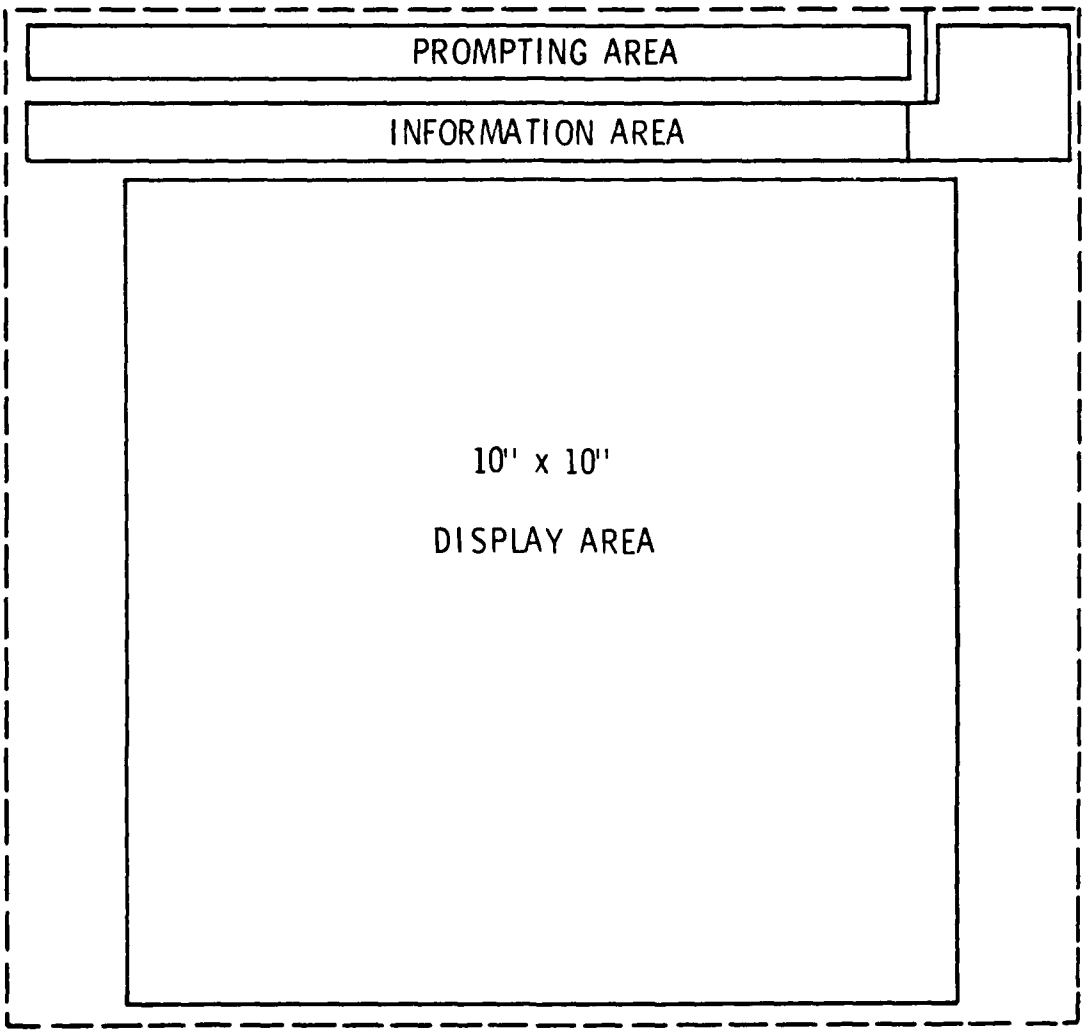


Figure 6. Format of IBM 2250-3 Display Unit. The program adjusts the size of the displayed image to fill the 10" x 10" display area. Selecting a front view may cause the man-model and crew station to appear larger, but the coordinate information remains unchanged.

Replies to prompting messages are given through the Alphanumeric Keyboard (ANKB), the Light Pen, or the Programmable Function Keys (PFK). Replies given through the ANKB are displayed in the Prompting Area below the prompting message and are processed by the program after simultaneously depressing the ALT CODING key and the "5" key.[1] Replies that require using the light pen are given by depressing the light pen barrel aimed at the desired response displayed on the screen.

Figure 7 shows the IBM 2250-3 CRT in use. The user's left hand is on the Program Function Keyboard, and his right hand is using the light pen to identify a point on the screen. The Alphanumeric Keyboard is shown below the CRT.

2.1.1 Functions Available

The functions which are available to the user fall into six basic categories, as shown in Figure 8. The first category, the Anthropometry Related functions, enables the user to retrieve data for a particular anthropometric survey from the Anthropometric Data Base, specify values for the surface dimensions of the man-model, and manipulate the geometry of the model to achieve the desired man-model configuration. The Crew Station-Related functions let the user retrieve existing three-dimensional crew station configurations from the Crew Station Data Base and then add to and modify the retrieved configuration. These functions also allow the user to start from the beginning of a design sequence and create a new crew station configuration. The Display-Related functions allow the user to rotate and to magnify the contents of the display area. They also enable the user to identify objects within the Display Area, or modify the contents by omitting or by including objects. The user can evaluate

[1] In subsequent use in the text the simultaneous depression of the "ALT-CODING" and "5" keys will be referred to as the ALT-CODE/5 sequence. IBM refers to this sequence as EOB (End of Block). (IBM System Reference Library, Program Numbers 360S-LM-537.)

. CRT Unit with Function Keys, Alphanumeric Keyboard and Light Pen.

the interaction of man-model with crew station through the Man-Machine Interaction Related functions. These functions provide the user with a reach analysis routine and change posture functions. The Printer/Plotter Related functions supply the user with hard-copy output of the configuration of either the man-model or the crew station. The program generates plot output as soon as a plot function is activated, but the printed output occurs only at the end of the run. The final category, the Program Execution Related functions, permits the user to restart the program, or to end it. It also enables the user to set State Switches which either suppress or activate additional processing or printing.

A standard feature of the program is a listing of all actions taken by the user. This is a sequence of messages printed at the termination of the program CBM04.

2.1.2 Requirements

At the Wright-Patterson Air Force Base AFAMRL HESS facility, the program CBM04 runs on an IBM 370/155 Operating System Computer using a 2250-3 graphics display terminal with light pen, alphanumeric keyboard, and program function keyboard, and an on-line Gould 4800 plotter. The program requires 550K bytes computer memory and a minimum of 20K bytes graphics buffer control area. The Initialization, Anthropometric, Crew Station and Visibility Data Bases reside on a disk drive in a direct access format. The space requirement for each data base depends on the number of members and their complexities. IBM System/360 Operating System Graphic Subroutine Package (GSP) for FORTRAN IV is used to create displays on the CRT. Gould 4800/5000 IBM System/360/370 Plot package is used for on-line plotting.

Other requirements for specific functions will be described in the appropriate paragraphs which follow.

ANTHROPOMETRY-RELATED	CREW STATION -RELATED	DISPLAY-RELATED
Retrieve Anthropometry	Retrieve Crew Station	Change View
Enter Twelve Dimensions	Design Panel	Identify Object
Enter Two Key Dimensions	Delete Panel	Omit Object
Display Link Table	Adjust Seat	Include Object
		Change Perspective

MAN-MACHINE-INTERACTION RELATED	PRINTER/PLOTTER-RELATED	PROGRAM-EXECUTION RELATED
Perform Reach	Print Data	Set State Switch
Change Posture	Plot COMBIMAN	Restart CBM04
Reset Roll, Pitch, Yaw	Generate Visibility Plot	End CBM04

Figure 8. Functions Available to COMBIMAN User.

2.2 AVAILABLE PROCESSING

Functions of Program CBM04 are requested by means of the Program Function Keyboard (PFK). This keyboard consists of 32 keys, numbered 0 to 31, whose functions are assigned by program CBM04. When a function is enabled, the appropriate button on the PFK will be lighted. The primary functions for Program CBM04 are shown on the PFK Overlay Mask in Figure 9. The circles in Figure 9 represent the PFK keys. Their numbers are shown above and to the left of each circle. The numbers within the circles represent the subsections where the functions are described. For example, PFK0 contains a "1" within the circle and is described in Paragraph 2.2.1. A function is requested by a single, momentary depression of the corresponding PFK.

Once the program is loaded (for instructions on loading, see Paragraph 2.3.1) the prompting area of the screen will display the message "DEPRESS PFK4". The first sequence of steps the user follows should utilize the Anthropometry Related functions to generate the man-model. The mandatory sequence is shown in Figure 10. The number in each block refers to the paragraph which describes the function.

After the man-model is generated and displayed on the CRT, the user may choose to manipulate the man-model using the Display-Related functions, or may retrieve or develop a crew station using the Crew Station Related functions. When using the Crew Station Related functions, the RETRIEVE CREW STATION Function (Paragraph 2.2.6) should be selected before deleting panels. The Program Execution Related functions (see Figure 8) are always enabled and may be depressed at any time during the execution of CBM04.

The following paragraphs describe the processing performed by each function as numbered in Figure 9.

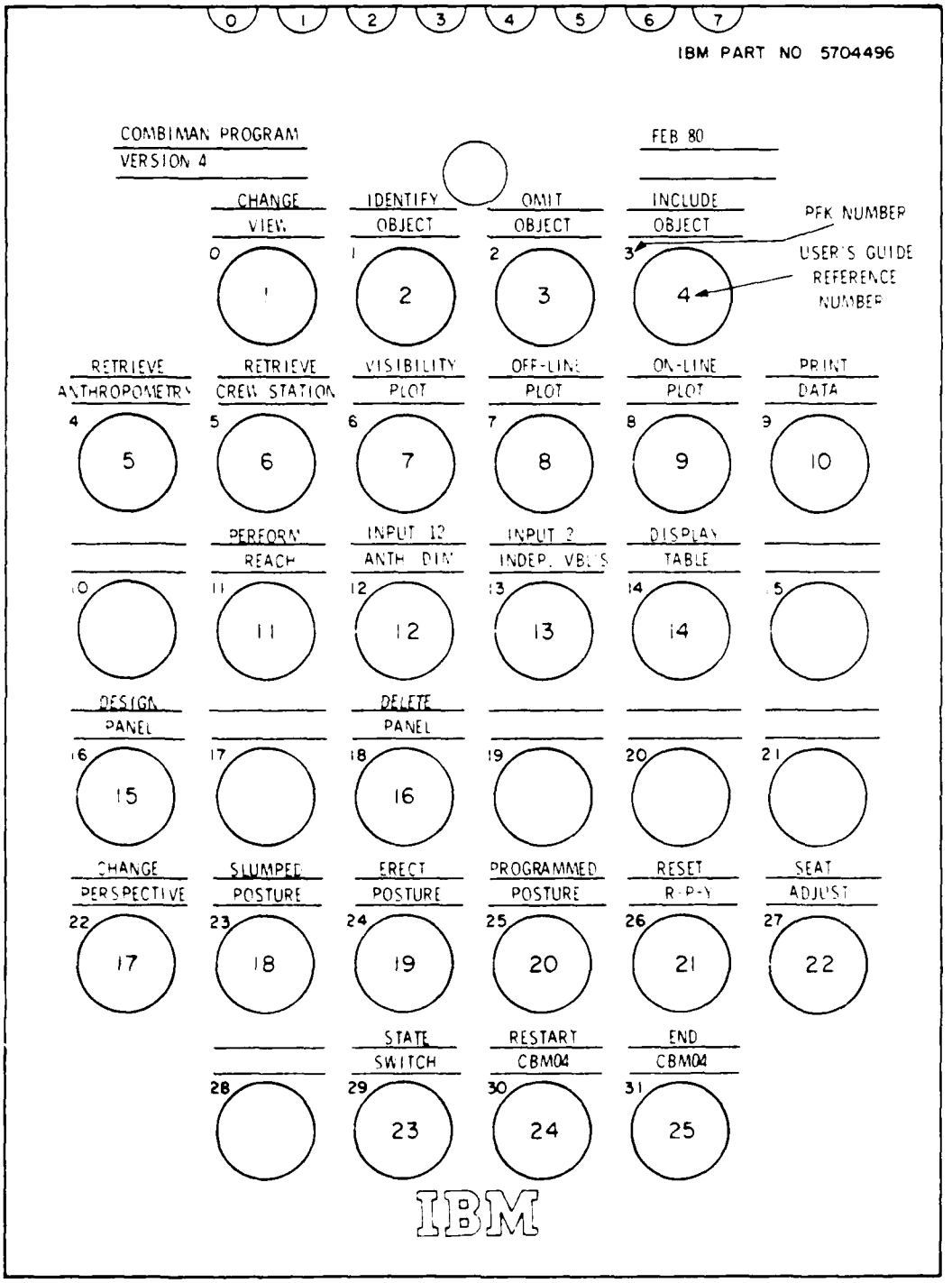


Figure 9. Program Function Keyboard (PFK) overlay for Program CBM04.

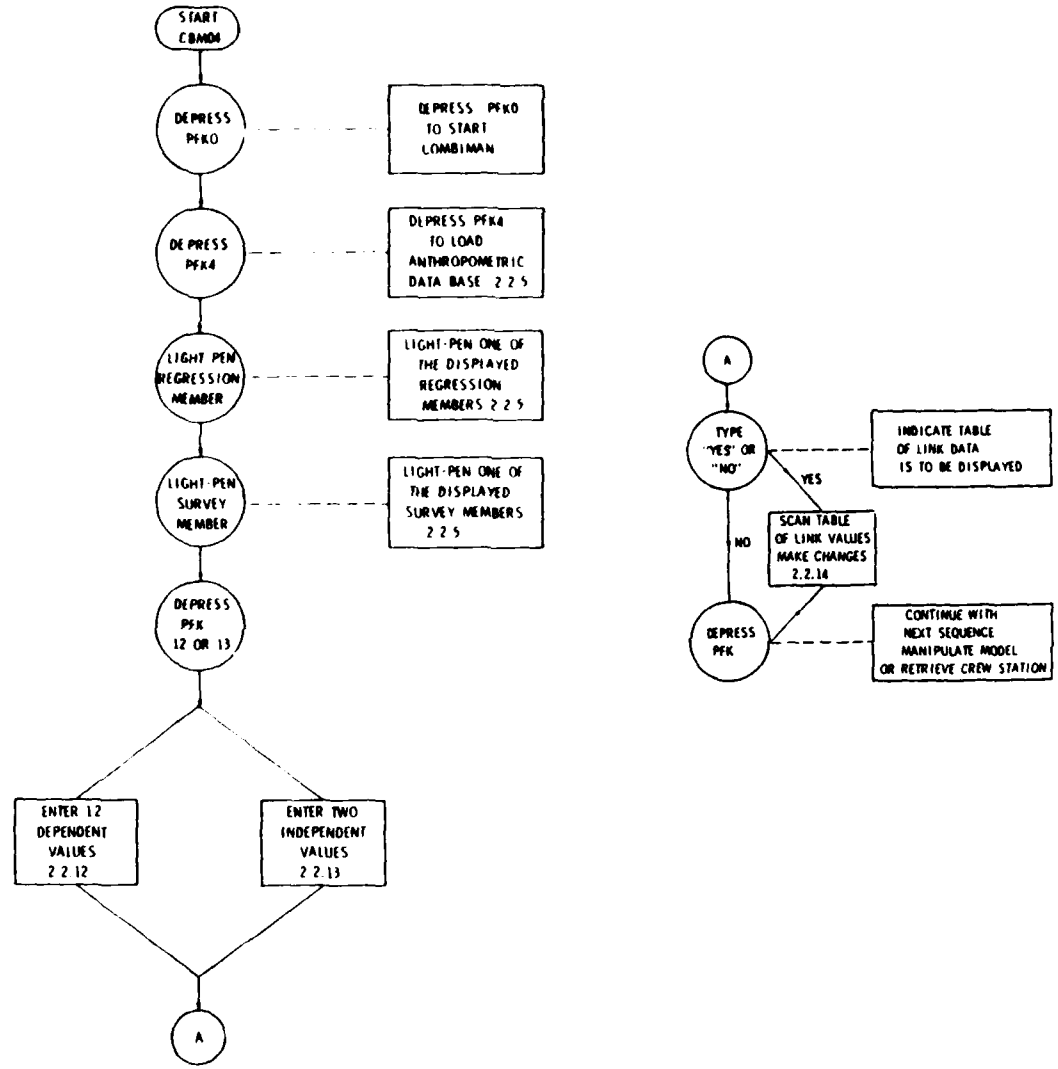


Figure 10. Function Sequence for Generating the Man-Model.

2.2.1 CHANGE VIEW Function (PFK0)

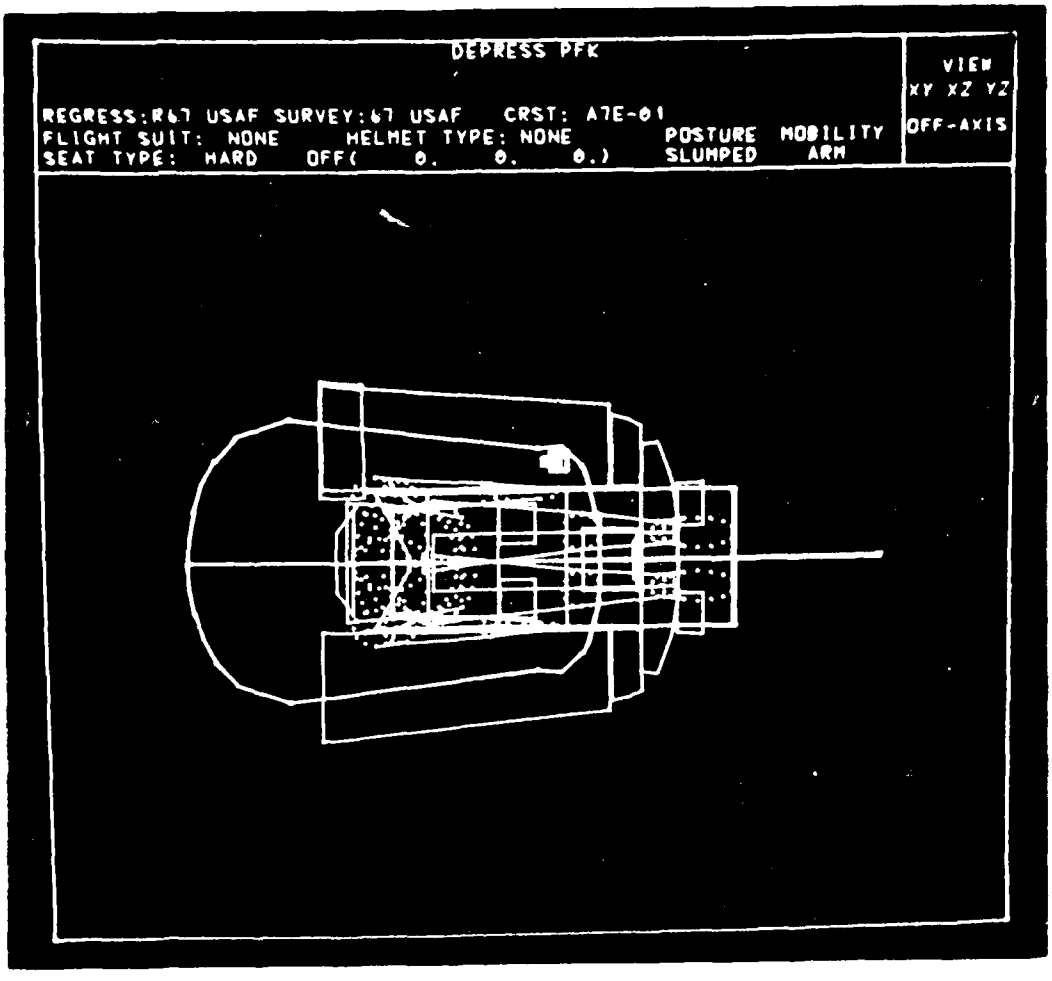
The CHANGE VIEW function allows the user to rotate the figure shown in the display area of the screen (see Figure 6).

Once this function key has been selected, the program prompts the user to select either a new view-plane for the display area, or to define a new off-axis orientation of the man-model and crew station. To change the view-plane, the user responds to the message "L.P. VIEW CHANGE" by light penning "XY" for a top view, "XZ" for a side view, or "YZ" for a front view of the man-model and crew station. Then the program regenerates the display in the new viewplane. Figure 11a, b, and c shows the display of COMBIMAN in the A7E-01 cockpit in the XY (top), XZ (side), and YZ (front) view-planes respectively.

If the user has responded to the message "L.P. VIEW CHANGE" by light penning "OFF-AXIS" in the upper-right corner of the screen, the program prompts the user to enter the new roll, pitch, and yaw angles. Angles are specified from the keyboard in degrees. Once the value is typed, the user presses the ALT-CODE/5 sequence to enter the number. If the user does not wish to change the angles, simply depress the ALT-CODE/5 sequence for the angle(s) not to be changed. The following sequence of replies would rotate the man-model and crew station of Figure 11b to ROLL = 0°, PITCH = 15°, and YAW = -15°.

```
ALT-CODE/5  (ROLL was already 0°)
   15       (changed pitch to 15°)
ALT-CODE/5  (enter PITCH = +15°)
  -15       (change YAW to -15°)
ALT-CODE/5  (enter YAW = -15°)
```

Once the ALT-CODE/5 sequence for the YAW angle is entered, the display will be rotated.


DEPRESS PFK
VIEW
XY XZ YZ
REGRESS:R67 USAF SURVEY:67 USAF CRST: A7E-01
FLIGHT SUIT: NONE HELMET TYPE: NONE POSTURE MOBILITY
SEAT TYPE: HARD OFF(0. 0. 0.) SLUMPED ARM
OFF-AXIS

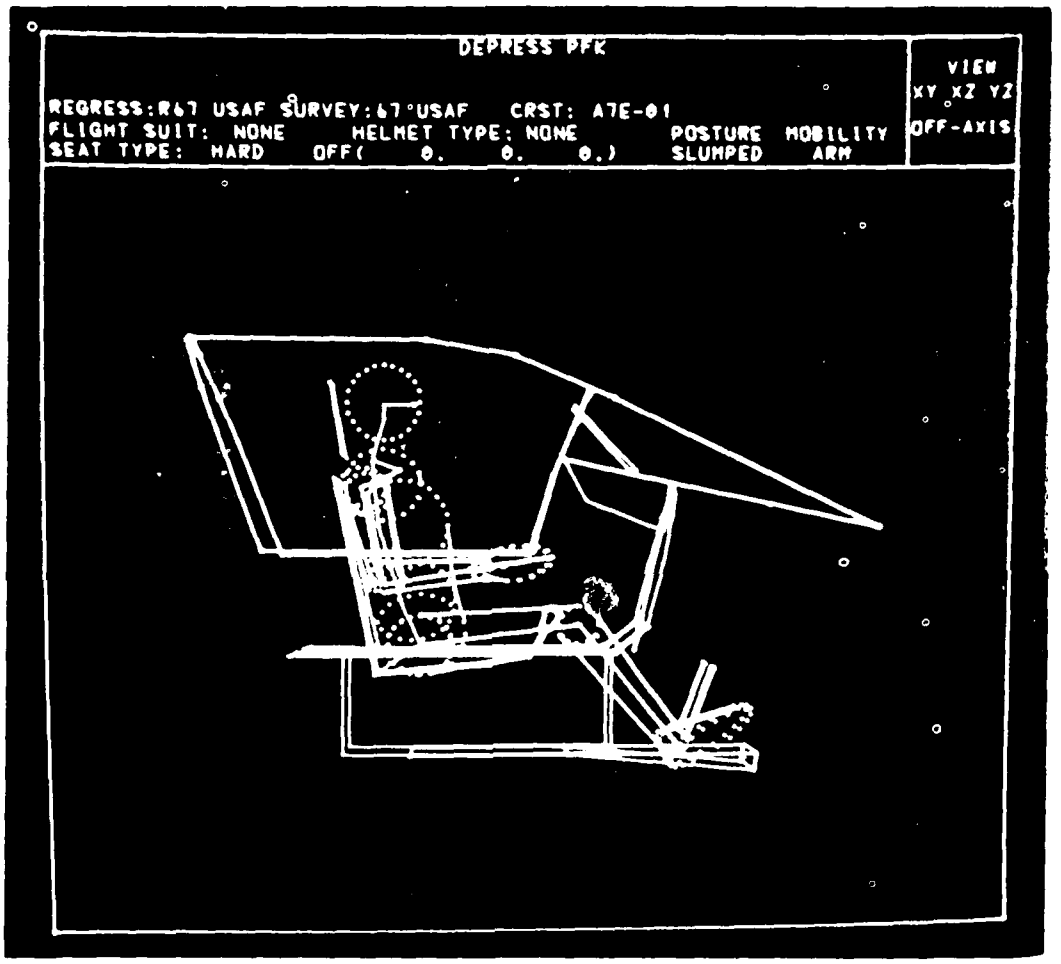


Figure 11b. Side View (X-Z Plane) of the Man-Model and a Crew Station.

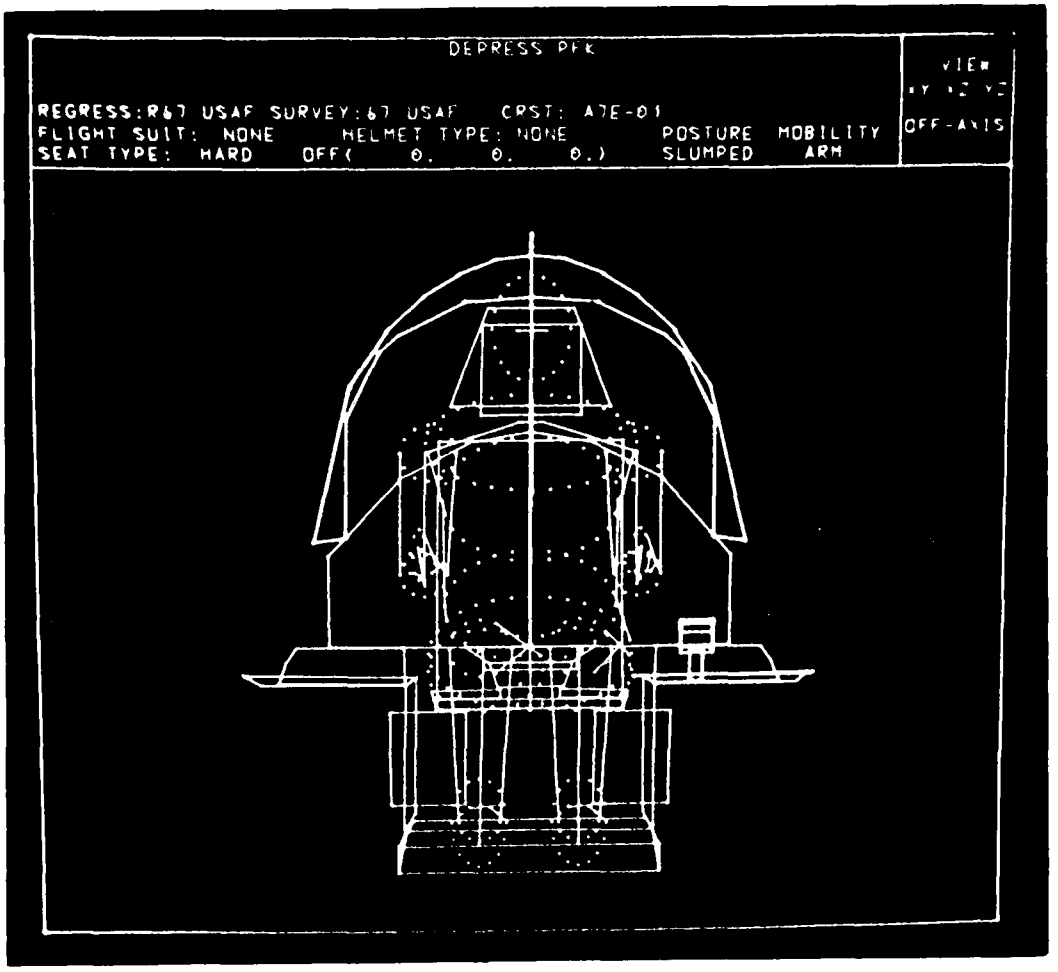


Figure 11c. Front View (Y-Z Plane) of the Man-Model and a Crew Station.

2.2.2 IDENTIFY OBJECT Function (PFK1)

The IDENTIFY OBJECT function displays identifying information in the Information Area of the CRT for any object (man-model skeletal link or crew station panel) chosen by the user. After depressing PFK1, the message "LIGHT-PEN OBJECT" appears in the Prompting Area of the CRT. The user must then light-pen the object to be identified.

The following three pieces of information are then displayed in the Information Area of the CRT for the light-penned object:

1) The internal reference number of the object,
2) Reference coordinates for that object, and
3) The 8-character name of the object.

The internal reference number is a unique integer, assigned by the program, which identifies each link or panel. The reference coordinates for the object are the X, Y, and Z coordinates of the distal end point for a man-model link or the X, Y, and Z coordinates of the first vertex (as defined in the Data Base - see Section 5) of a selected panel. The 8-character name of the panel was assigned to the panel when the crew station was added to the Data Base. Figure 12 shows the result of an IDENTIFY OBJECT function performed on the HUD (heads up display) for the A7E-01 crew station. The message in the Information Area of the CRT,

62 22.10 3.15 32.37 HUDSCRN

indicates that its internal reference number is 62, the coordinates of its first vertex are X = 22.10, Y = 3.15, and Z = 32.37, and its name is HUDSCRN.

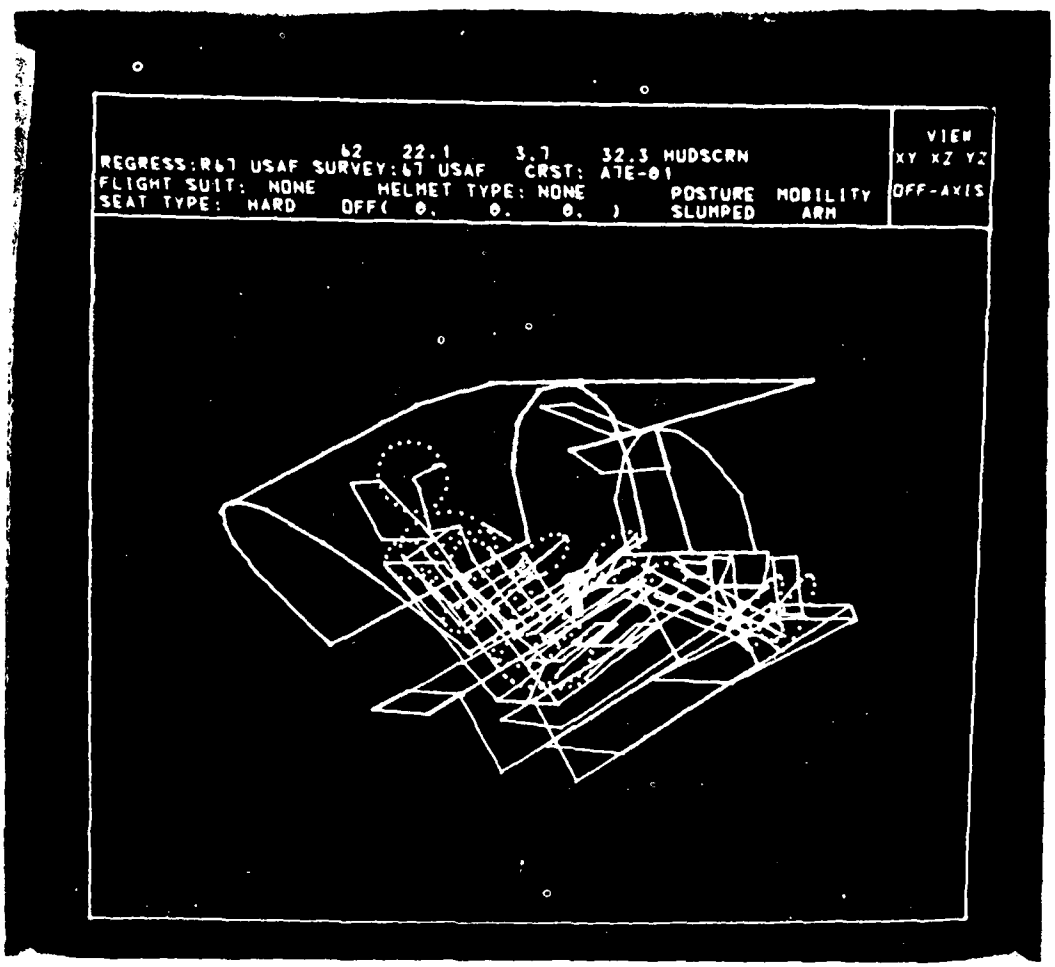


Figure 12. The Identify Object function performed on the HUDSCRN (Heads Up Display) for the ATE-01 Crew Station.

2.2.3 OMIT OBJECT Function (PFK2)

The OMIT OBJECT function temporarily removes a crew station panel or a man-model segment from the display. This function is used in "decluttering" the display.

On depressing PFK2, the message "LIGHT-PEN OBJECT" appears in the Prompting Area of the CRT. The user must then light-pen the object to be omitted. The program then displays the internal reference number of the object, the X, Y, and Z coordinates of the distal-end point of the selected man-model link or the X, Y, and Z coordinates of the first vertex of the selected panel, and the 8-character name of the object in the Information Area of the CRT. The internal reference number of the object is a unique integer, assigned by the program, which identifies each link and panel. It is the same number that the IDENTIFY OBJECT function displays and must be supplied by the user if the INCLUDE OBJECT function (see Paragraph 2.2.4) is used. The user may wish to write down these numbers for future reference. Any omitted object can be redisplayed by supplying its internal reference number in the INCLUDE OBJECT function. Also, all omitted objects are redisplayed whenever the man-model and crew station are regenerated (e.g. during a CHANGE VIEW function or a function which involves use of the cross symbol). Figure 13a shows the message created by the OMIT OBJECT function and A7E-01 crew station with the heads up display screen (HUDSCRN) and 13b with the HUDSCRN omitted. Note that the message generated by the OMIT OBJECT function is identical to that of the IDENTIFY OBJECT function.

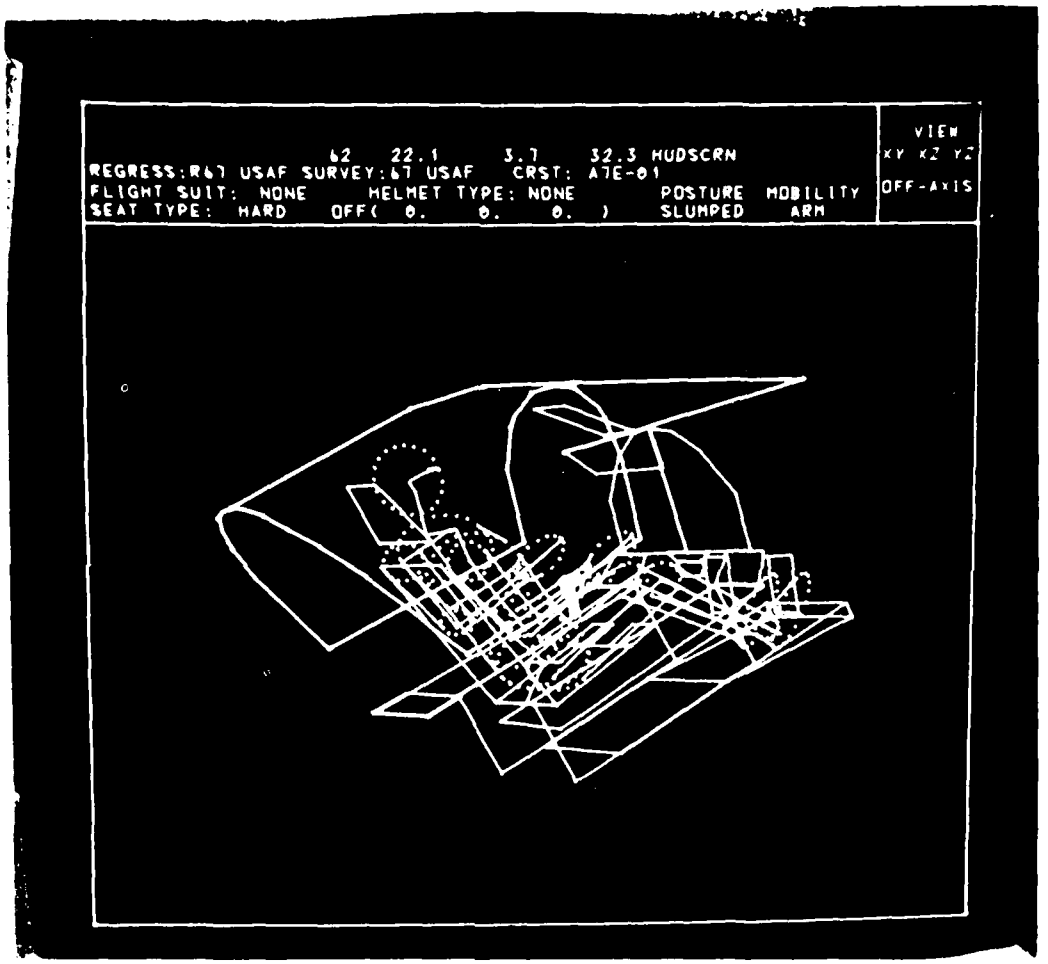


Figure 13a. The OFFT OBJECT Function Portrayed on the HUDSCRN (Heads Up Display) for the A7E-01 Crew Station.

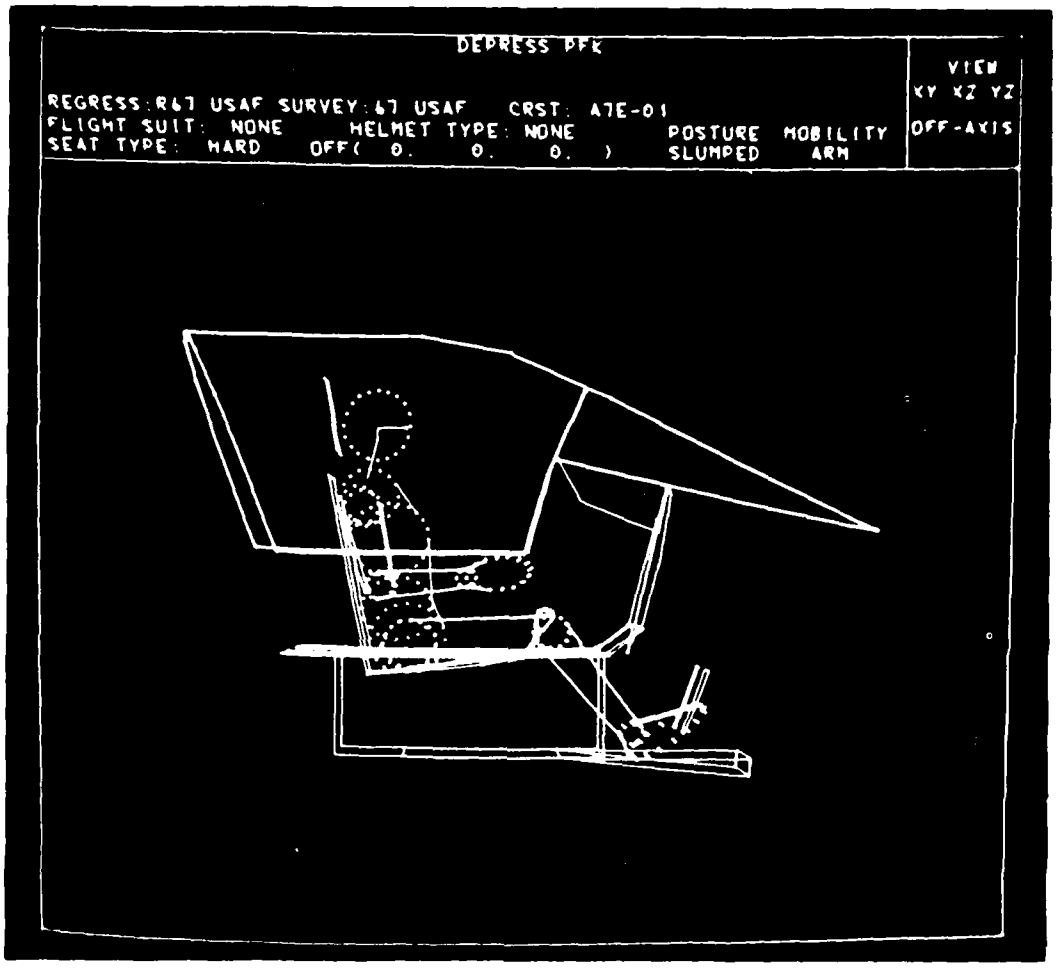


Figure 13b. The OMIT OBJECT Function Performed on the HUDSCRN (Heads Up Display) for the A7E-01 Crew Station.

2.2.4 INCLUDE OBJECT Function (PFK3)

The INCLUDE OBJECT function redisplays an object that was removed from the screen by the OMIT OBJECT function. After depressing PFK3, the message "ENTER OBJECT NUMBER" appears in the Prompting Area of the CRT. The number is entered through the ANKB followed by the ALT-CODE/5 sequence. The only valid entries for this function are internal reference numbers of man-model skeletal links or crew station panels which have previously been deleted by the OMIT OBJECT function. The program will keep prompting for a valid internal key number until the user supplies one or enters the ALT-CODE/5 sequence to ignore the function and return to the main program. There are no other messages associated with this function. Depressing PFK3 and entering key number 62 (HUDSCRN reference number) for the INCLUDE OBJECT function for Figure 13b would cause the heads up display screen to reappear in its original position in the crew station. The man-model and crew station display will once again look like that of Figure 13a.

2.2.5 RETRIEVE ANTHROPOMETRY Function (PFK4)

This function is the first step in defining the size of the man-model. The user is first prompted to light-pen the name of a "regression member" from the Anthropometric Data Base (see Figure 14). (A detailed explanation of regression and survey members is given in Section 4.) Regression membernames are displayed in the column headed "REGRESSION MEMBER", as shown in Figure 14. If the 1967 Survey of the USAF Flying Personnel is desired the user must light-pen R67 USAF, and if the 1970 Survey of U.S. Army Aviators is desired the user must light-pen R70 ARMY*. Once a membername is light-penned, the message "MEMBER membername ACCEPTED" will be displayed in the information area of the screen.

After the regression data are retrieved from the Data Base, the user must light-pen the Survey member name displayed on the CRT which corresponds to the selected regression displayed in the column headed "SURVEY MEMBER", as shown in Figure 15. (Only one survey for each regression member supplied in this version.) While the message "MEMBER membername ACCEPTED" is displayed in the Information Area, the means, standard deviations, and percentiles for the anthropometric dimensions are retrieved from the Data Base.

The message "DEPRESS PFK 12 or 13" then appears in the Prompting Area of the CRT. Here the user selects the anthropometric surface dimensions or internal link lengths vital to the generation of the man-model. The sequence of steps associated with these function keys is described in Subsections 2.2.12 and 2.2.13.

While the computations for the anthropometry are in progress, the message "HUMAN ASSEMBLY" is displayed in the Information Area of the CRT. After this, the information is assembled for display and the message "CREATING DISPLAY" is displayed in the Information Area of the CRT. The new man-model (and crew station if one was previously cued) will appear on the screen.

*NOTE: Other sets of survey data will be available in future updates of COMBIMAN or the user may create new members using the COMBIMAN Anthropometric Data Base Maintenance program (CBMAM).

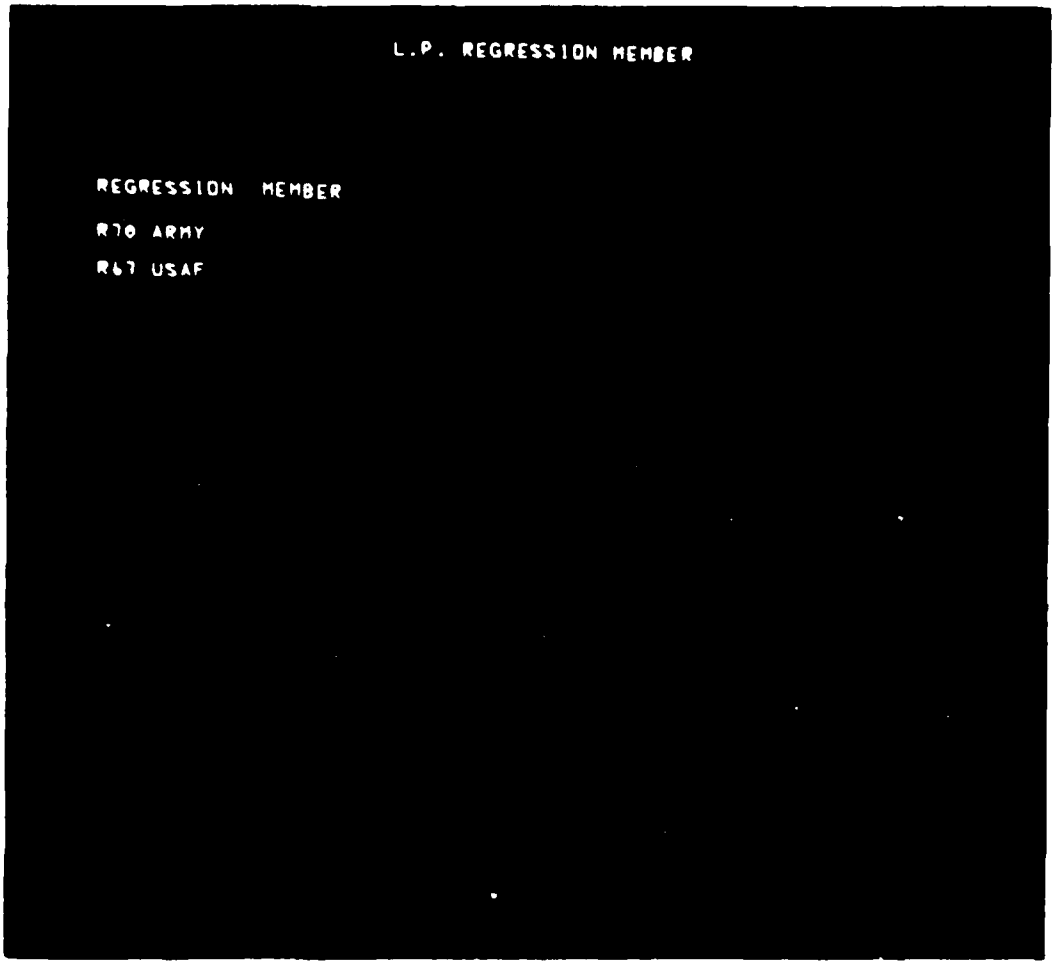


Figure 14. Table of Available Regression Member Names - One Must Be Selected.

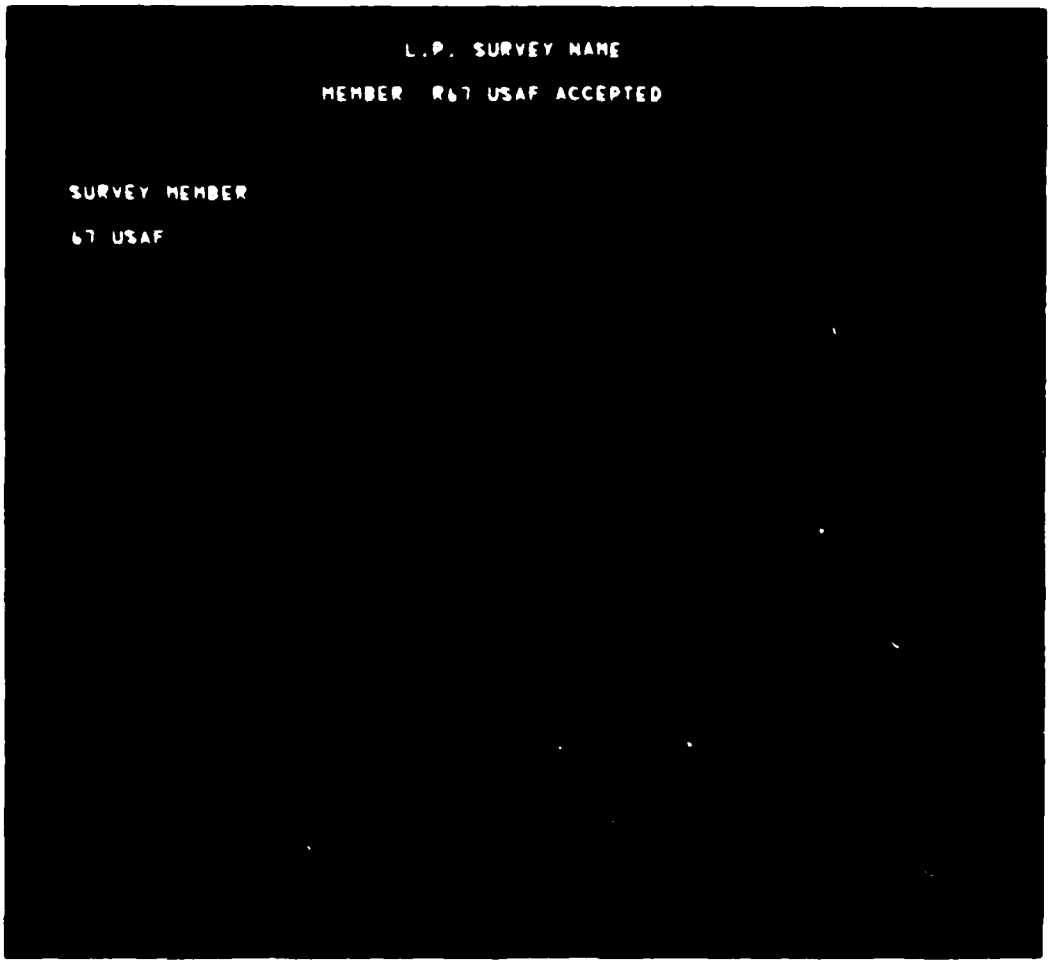


Figure 15. Table of Survey Members Screen
for Selection.

2.2.6 RETRIEVE CREW STATION Function (PFK5)

The RETRIEVE CREW STATION function allows the user to retrieve a crew station from the Crew Station Data Base. After PFK5 is depressed, the user is prompted to light-pen a crew station. The crew station membernames are shown in Figure 16a; crew stations without seats are listed in the first column, and the seats are listed in the second column. The third column contains "(ERASE)" and "(NONE)". If a crewstation name is light-penned without erasing the previous crew station, both crew stations are displayed superimposed. If "NONE" is light-penned, the RETRIEVE CREW STATION function is cancelled. In order to erase an existing crew station from the display area, depress PFK5 and light pen "(ERASE)". When intentionally superimposing two or more crew stations, if the total number of panels exceeds 250, the message "TOO MANY PANELS/ VERTICES * RETRY" appears in the Prompting Area of the CRT Screen. The program then redisplays the crew station membernames (see Figure 16b). The user may light-pen "(NONE)" to cancel the last entry and relieve the overflow condition.

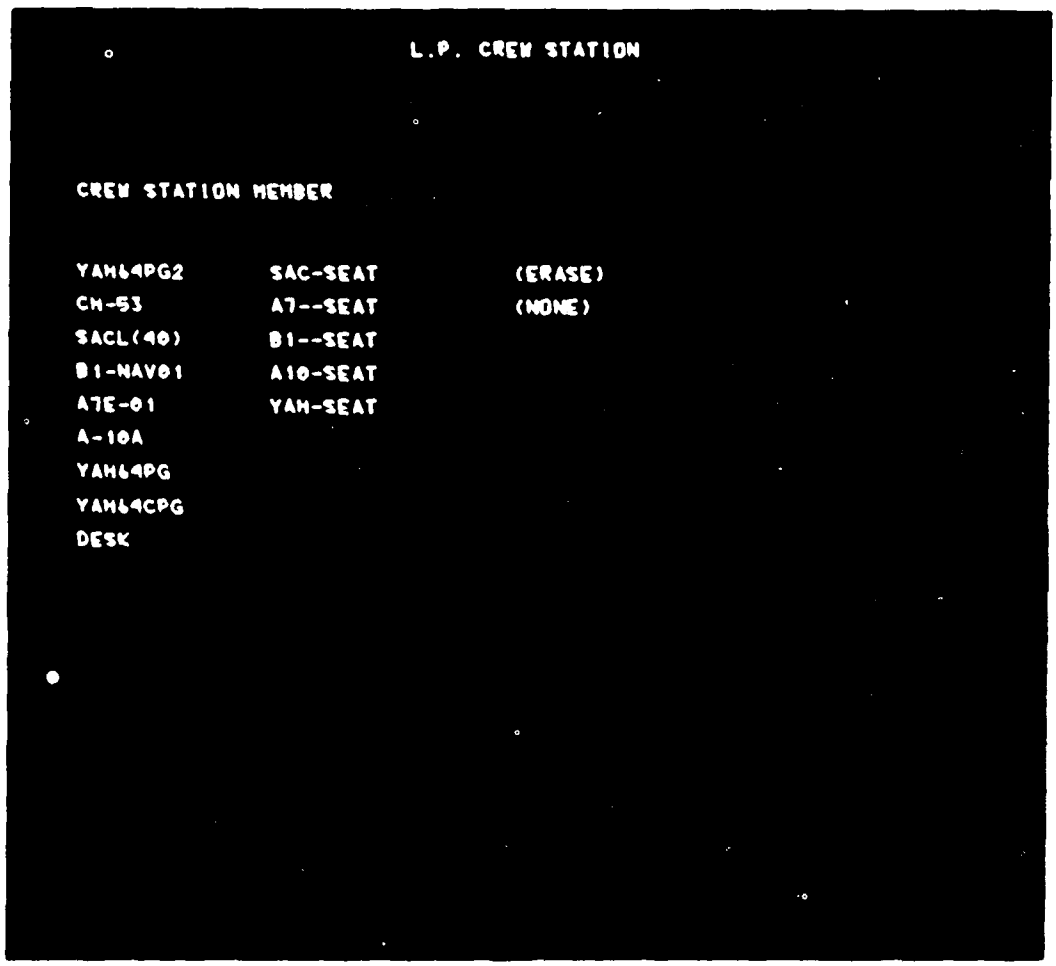


Figure 16a. Table of Available Crew Station Members

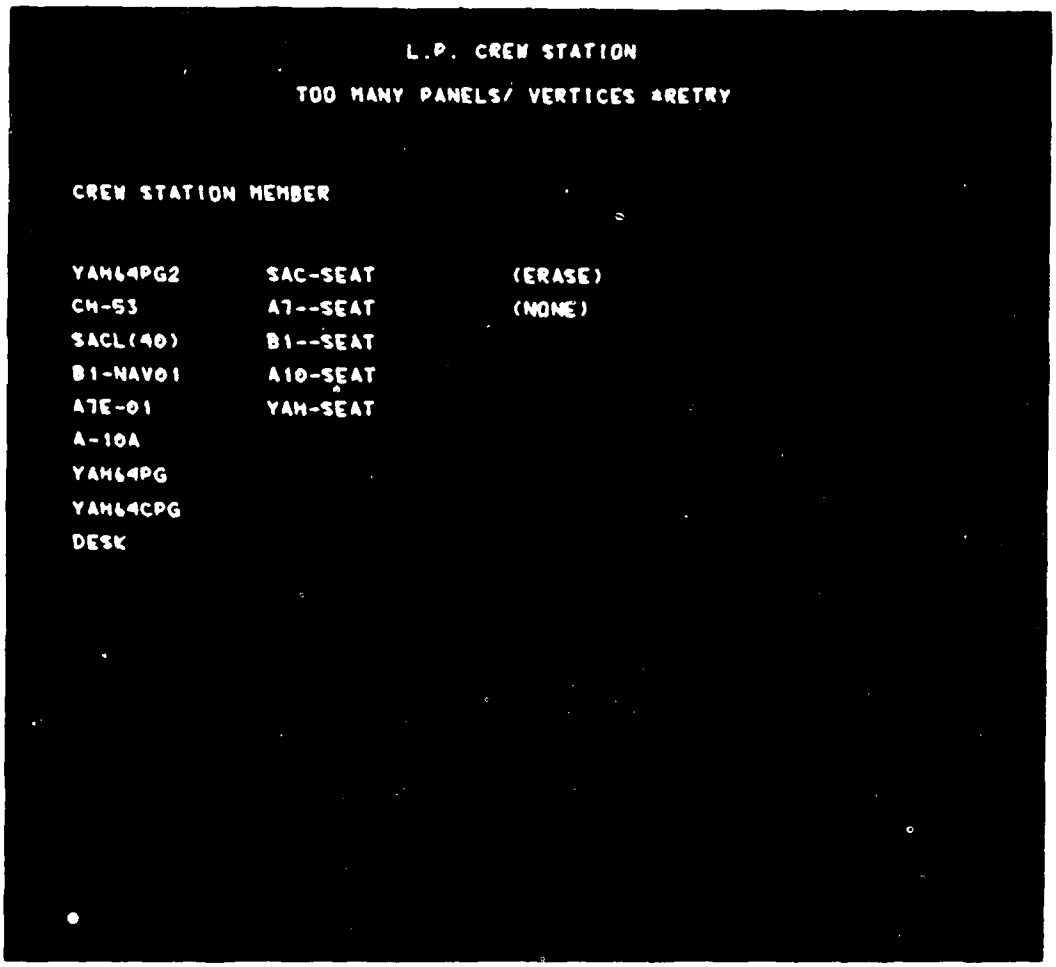


Figure 16b. Table of Available Crew Station Members as Displayed When the Total Number of Panels Exceeds 250.

2.2.7 VISIBILITY PLOT Function (PFK6)

The VISIBILITY PLOT function plots a map of visual azimuth and elevation line-of-sight angles to crew station characteristics in the Visibility Data Base, as defined in MIL-STD-850, Rectilinear Plot. However, the plot of visual angles reflects the current orientation of the man-model, as he would see the crew station from his viewpoint. After depressing PFK6 the message "ENTER EYE LOCATION (LINK)" appears in the Prompting Area of the CRT. The user must select the reference eye point to be used for the plot by entering "8" for Mid-Eye, "9" for Right Eye, or "10" for Left Eye using the ANKB. This entry should be followed by the ALT-CODE/5 sequence. The user then light-pens the desired visibility member from the column under the heading "VISIBILITY MEMBER". Now the message "PLOTTING" is displayed in the Information Area of the CRT and the plot is generated on the graphic plotter. This routine uses the coordinates which define the vector from the mid-head position to mid-eye position (link 8) to calculate the angular orientation of the head from the horizontal and from the vertical. If the man-model is facing forward and looking straight ahead, the orientation of his head would be 0° from horizontal and 0° from vertical.

Figure 17 shows a sample visibility plot of a canopy clearline for a single seat aircraft. For this example, the man-model is 50th percentile weight and sitting height from the 1967 USAF Survey, seated erect, looking straight ahead.

The four ellipses superimposed on the plot define the limits of various visual fields. The inner most field, defined with the letter S, is the field of stereo vision, the field visible to both eyes simultaneously. The field defined with the letter F, is the field of fixation, what the eyes can see directly without turning the head. The field defined with the letter P, is the field of peripheral vision with the eyes caged with respect to the head. The outermost field, defined with the letter M, is the maximum peripheral vision limits for the extreme eye deviation.

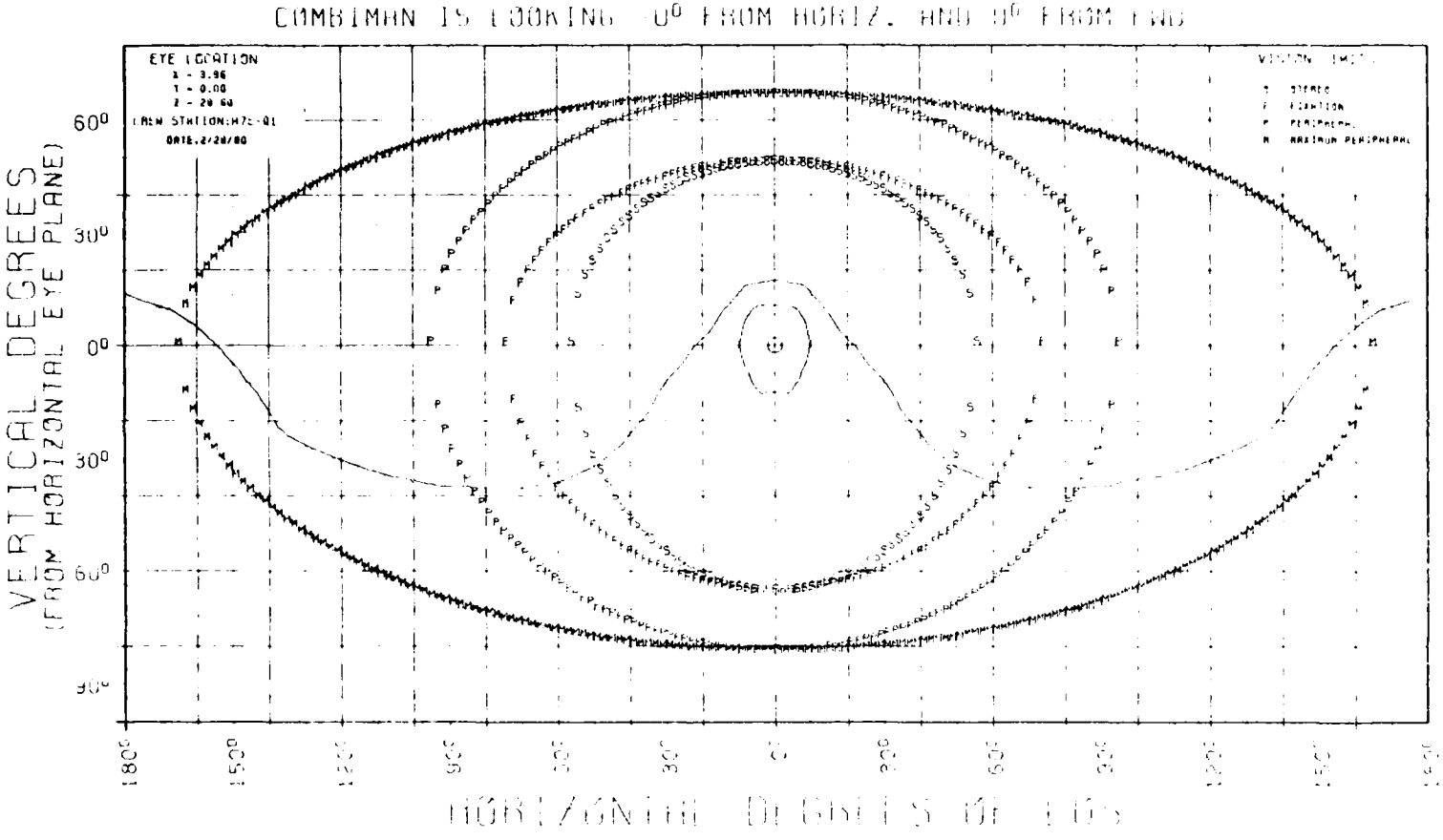


Figure 17. Visibility Plot.

The symbol " " is the aim point of the head (and eyes if the eyes are caged forward with respect to the head). The vision limits are generated with respect to the angle of sight from the Mid-Eye point (link 8 end point).

In addition to generating a hard copy plot, the routine also calculates and prints a cross-reference listing of the three dimensional coordinates of the objects plotted in five degree azimuth increments from -180° from horizontal line of sight to +180° for each panel and/or contour in the visibility member. This listing is a handy reference to the crew station drawings. The coordinates are given in the original user-supplied system of coordinates rather than the NSRP system of coordinates used elsewhere (see Paragraph 5.3.2.1). The listing also gives the coordinates of the eye location of the man-model. Figure 18 shows a part of the coordinate data for the plot in Figure 17.

COMO4 --- COMBIMAN PROGRAM, VERSION 4

VISIBILITY PLOT DATA FOR COCKPIT CANOPY CLEARLINE

EYE LOCATION IN AIRCRAFT SYSTEM (261.63, -6.30, 130.45)

HORIZ. ANGLE	AIRCRAFT COORDINATES FS	BL	WL	HORIZ. ANGLE	AIRCRAFT COORDINATES FS	BL	WL	HORIZ. ANGLE	AIRCRAFT COORDINATES FS	BL	WL
-180	287.029	31.429	117.110	-60	246.732	9.584	134.641	60	264.766	-5.891	114.861
-175	282.691	31.135	116.900	-55	246.862	8.599	133.816	65	265.947	-5.945	114.925
-170	279.055	30.929	116.879	-50	247.046	7.273	132.282	70	267.199	-6.008	114.997
-165	275.839	30.663	115.780	-45	275.653	6.000	130.474	75	268.634	-6.183	115.131
-160	273.013	30.475	115.521	-40	247.661	4.780	129.112	80	270.234	-6.331	115.278
-155	270.499	30.451	115.303	-35	248.041	3.609	127.648	85	272.032	-6.433	115.436
-150	268.155	30.464	115.086	-30	248.482	2.435	126.217	90	274.143	-6.544	115.624
-145	265.820	29.933	114.911	-25	248.921	1.385	124.826	95	276.816	-6.768	115.866
-140	263.680	29.774	114.726	-20	249.475	0.346	122.679	100	280.153	-6.991	116.183
-135	261.600	29.588	114.510	-15	250.145	-0.614	120.957	105	284.623	-7.293	116.582
-130	259.555	29.366	114.329	-10	250.868	-1.515	119.356	110	289.095	-6.821	119.508
-125	257.515	29.167	114.267	-5	251.656	-2.344	117.943	115	290.397	-4.481	123.408
-120	255.432	29.019	114.353	0	252.389	-3.211	116.655	120	291.528	-2.019	126.726
-115	253.525	28.186	115.370	5	253.220	-3.987	115.566	125	292.366	0.575	129.463
-110	251.938	26.720	117.420	10	254.165	-4.819	114.945	130	293.100	3.244	131.662
-105	250.536	25.163	120.020	15	255.245	-5.037	114.415	135	293.635	6.000	133.339
-100	249.367	23.471	123.113	20	256.416	-5.117	114.208	140	293.959	8.831	134.350
-95	248.513	21.596	126.126	25	257.522	-5.204	114.165	145	294.433	11.789	135.423
-90	247.806	19.792	128.547	30	258.586	-5.247	114.255	150	294.015	14.686	134.523
-85	247.338	17.967	130.523	35	259.595	-5.371	114.337	155	293.672	17.674	133.455
-80	246.978	16.238	132.867	40	260.594	-5.493	114.419	160	293.116	20.696	131.710
-75	246.765	14.565	134.544	45	261.600	-5.606	114.522	165	292.286	23.717	129.219
-70	246.608	12.963	134.829	50	262.625	-5.720	114.630	170	291.244	26.757	125.882
-65	246.644	11.444	134.901	55	263.681	-5.805	114.743	175	289.808	29.669	121.631

Figure 18. Canopy Outline Coordinates in Aircraft System.

2.2.8 OFF-LINE PLOT COMBIMAN Function (PFK7)

The OFF-LINE PLOT COMBIMAN function saves the coordinate data of the man-model and crew station currently on the CRT for later use in generating a plot. The prompting and informational messages for this function and the necessary replies are identical to those for the ON-LINE PLOT COMBIMAN function of Paragraph 2.2.9.

After depressing the OFF-LINE PLOT function key (PFK7) the message "PERSPECTIVE PLOT (Y/N)?" is displayed in the Prompting Area of the CRT (see Figure 19). Here the user has the option to select a perspective or a nonperspective plot. A perspective plot shows the man-model and crew station with infinite perspective (as displayed on the CRT). Nonperspective is plotted in a rectangular coordinate system. The user types "Y" or "YES" for a perspective plot, or "N" or "NO" for a nonperspective plot using the ANKB, and depresses the ALT-CODE/5 sequence.

The program then displays the message "ENTER SCALE FACTOR" in the Prompting Area of the CRT. For a perspective plot, a scale factor of 1.0 produces a 10 x 10 inch plot identical to the size of the Display Area on the CRT. For nonperspective plots, the scale factor is applied to full-scale data. The user must consider the size restrictions of his plotter when specifying the scale factor. For example, a 1.0 scale perspective plot is about the same size as a 0.10 scale nonperspective plot.

To enter the scale factor, type the decimal value using the ANKB and then depress the ALT-CODE/5 sequence. When a valid scale factor (greater than 0.0) is entered, the message "PLOTTING" appears in the Informational Area of the CRT and the data are written to a disk file for later use as described in Section 3.

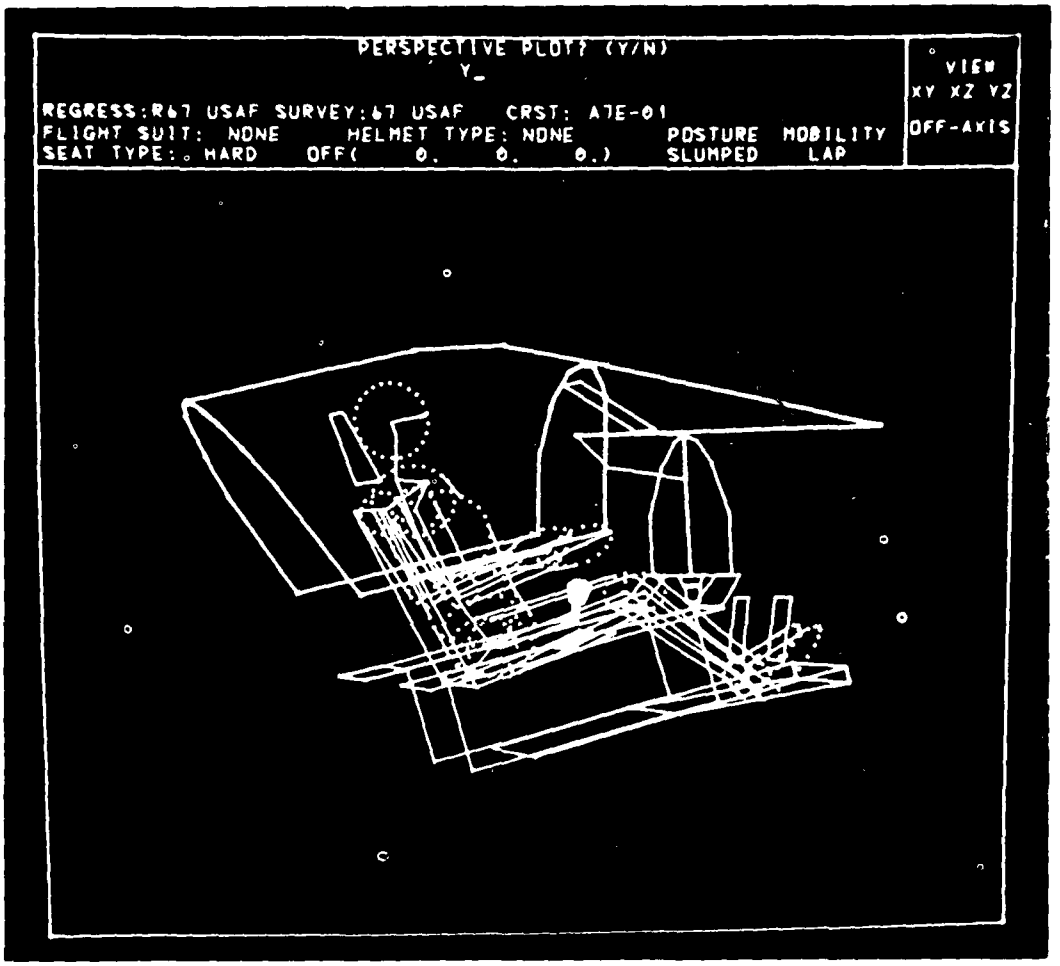


Figure 19. The Message and a Response for the COMPMAN Plot Function.

2.2.9 ON-LINE PLOT COMBIMAN Function (PFK8)

The ON-LINE PLOT COMBIMAN function generates on-line plots of the man-model and crew station configuration currently shown in the Display Area of the screen. After depressing the ON-LINE PLOT function key (PFK8), the user has the option of selecting a perspective or a nonperspective plot (see Paragraph 2.2.8) The program displays the message "PERSEPCTIVE PLOT (Y/N)?" in the Prompting Area of the CRT. The user must respond "Y" or "YES" for a perspective plot, or "N" or "NO" for a nonperspective plot, from the ANKB.

The program then displays the message "ENTER SCALE FACTOR" in the Prompting Area of the CRT (see Paragraph 2.2.8). To enter the scale factor, type the decimal value using the ANKB and then depress the ALT-CODE/5 sequence. When a valid scale factor (greater than 0.0) is entered the program displays the message "PLOTTING" in the Informational Area of the CRT, and the plotter generates the image. Note that the scale factor is applied to the display image size for perspective plots, but to the full scale coordinates for nonperspective plots.

2.2.10 PRINT DATA Function (PFK9)

The PRINT DATA function prints man-model and crew station data. The man-model data consists of, for each link the x, y, and z coordinates of the distal end of each link, the transformation angles for each link, and the enfleshment semi-axes lengths at the distal end of the link.

Data, for the crew station currently being displayed, consits of the name, type, and x, y, and z coordinates for each vertex of each panel. The coordinates of each control of the displayed crew station together with its name and name of the panel it is located on, if any, are also printed. An example of the output generated by the PRINT DATA function is shown in Figure 20.

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COMBIMAN LINK DATA

SURVEY DATA IS 67 USAF

NO.	NAME	DISTAL END X	DISTAL END Y	DISTAL END Z	JOINT ANGLES PHI	JOINT ANGLES THETA	JOINT ANGLES PSI	SEMI AXIS LENGTHS ALPHA	SEMI AXIS LENGTHS BETA	SEMI AXIS LENGTHS GAMMA
0	SRP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	SRP-MHIP	4.41	0.0	3.24	0.0	53.70	0.0	4.22	6.83	4.22
2	STOMACH	3.53	0.0	3.01	0.0	-64.20	0.0	3.88	5.46	3.88
3	CHEST	2.64	0.0	16.93	0.0	4.80	0.0	4.38	5.96	4.38
4	LWR NECK	3.17	0.0	24.01	0.0	10.00	0.0	3.18	7.69	3.18
5	UPR NECK	4.39	0.0	28.79	0.0	10.00	0.0	0.0	0.0	0.0
6	HID HEAD	4.39	0.0	30.13	0.0	-14.30	0.0	3.68	2.88	4.23
7	MH-MEYE	7.55	0.0	30.13	0.0	90.00	0.0	0.0	0.0	0.0
8	MEYE-REY	7.55	-1.25	30.13	-90.00	90.00	0.0	0.0	0.0	0.0
9	MEYE-LEY	7.55	1.25	30.13	90.00	90.00	0.0	0.0	0.0	0.0
10	LN-MBOSS	5.83	0.0	22.51	0.0	115.00	0.0	0.0	0.0	0.0
11	MSS-RSS	5.83	-1.00	22.51	-90.00	90.00	29.30	0.0	0.0	0.0
12	RSS-RSLD	1.97	-7.69	20.95	22.00	31.90	0.0	0.0	0.0	0.0
13	RSLDR	1.97	-7.69	20.95	0.0	-31.90	-112.00	2.21	2.16	1.95
14	RUPARM	1.97	-7.69	10.49	0.0	-90.00	-90.00	1.62	1.62	1.62
15	RLWARM	12.07	-7.69	10.49	0.0	90.00	0.0	1.05	1.05	1.05
16	RGRIPCTR	13.99	-7.69	10.49	0.0	0.0	0.0	1.92	0.51	3.61
17	RERGH	16.58	-7.69	10.49	0.0	0.0	0.0	0.0	0.0	0.0
18	RENGRTIP	19.30	-7.69	10.49	0.0	0.0	0.0	0.0	0.0	0.0
19	MSS-LSS	5.83	1.00	22.51	90.00	90.00	-29.30	0.0	0.0	0.0
20	LSS-LSLD	1.97	7.69	20.95	-22.00	31.90	0.0	0.0	0.0	0.0
21	LSLDR	1.97	7.69	20.95	0.0	-31.90	112.00	2.21	2.16	1.95
22	LUPARM	1.97	7.69	10.49	0.0	-90.00	90.00	1.62	1.62	1.62
23	LLWRARM	12.07	7.69	10.49	0.0	90.00	0.0	1.05	1.05	1.05
24	LGRIPCTR	13.99	7.69	10.49	0.0	0.0	0.0	1.92	0.51	3.61
25	LERGH	16.58	7.69	10.49	0.0	0.0	0.0	0.0	0.0	0.0
26	LENGRTIP	19.30	7.69	10.49	0.0	0.0	0.0	0.0	0.0	0.0
27	MHIP-RHP	4.41	-3.21	3.24	-90.00	90.00	53.70	2.92	2.92	3.70
28	RUPRLEG	20.60	-3.21	3.24	90.00	90.00	-90.00	1.99	1.99	1.99
29	RLWRLEG	20.60	-3.21	-12.10	0.0	90.00	0.0	1.32	1.32	1.32
30	ANK-RRCH	20.60	-3.21	-14.23	0.0	0.0	0.0	5.08	1.87	1.24
31	MHIP-LHP	4.41	3.21	3.24	90.00	90.00	-53.70	2.92	2.92	3.70
32	LUPRLEG	20.60	3.21	3.24	-90.00	90.00	90.00	1.99	1.99	1.99
33	LLWRLEG	20.60	3.21	-12.10	0.0	90.00	0.0	1.32	1.32	1.32
34	LNK-LRCH	20.60	3.21	-14.23	0.0	0.0	0.0	5.08	1.87	1.24

Figure 20. Output for COMBIMAN PRINT Function.

2.2.11 PERFORM REACH ANALYSIS Function (PFK11)

The PERFORM REACH ANALYSIS function causes the man-model to attempt an arm reach to a particular point in space.

First, the program prompts the user to light-pen the REACH MOBILITY: ARM, LAP, or SHOULDER (see Figure 21a). ARM mobility allows arm movement only while the shoulder and torso remain fixed. LAP mobility allows arm, shoulder, and torso movement. SHOULDER mobility allows arm and shoulder movement while the torso remains fixed. After the reach mobility has been selected, the program prompts the user to light-pen the REACH TYPE (see Figure 21b). There are two reach types, right arm (RARM) and left arm (LARM). After the type of reach has been selected, the program prompts the user to light-pen the EXTENT OF REACH. There are three choices; grip center (GRIPCTR) which indicates a grasping motion such as for a control stick, functional (FUNCT RCH) which indicates a pinching motion such as for turning a knob, and finger tip (FNGRTP) which indicates a touching motion, such as for a push button (see Figure 21c). Figure 1 shows the relative locations of these points on the hand. The hand on the man-model remains the same shape regardless of which grip type is selected. Once the extent of reach type has been selected, the program displays the man-model/crew station configuration in the X-Z plane (side view) in a non-perspective view (see Paragraph 2.2.8). The program then prompts the user to position the cross symbol ("+") at the point to be reached within the display area. The program uses a slewable "+" to locate and designate the 3-D coordinates of points of interest on the displayed image.

2.2.11.1 Positioning the Cross Symbol "+"

Initially, the program displays a cross symbol ("+") at the seat reference point (SRP) as shown in Figure 22. The user must first position the "+" in the X-Z plane (side view) to define the X and Z coordinates, and then in the Y-Z plane (front view) to define the Y-coordinate of the reach point. Note that the Z-coordinate can be redefined while positioning the cross

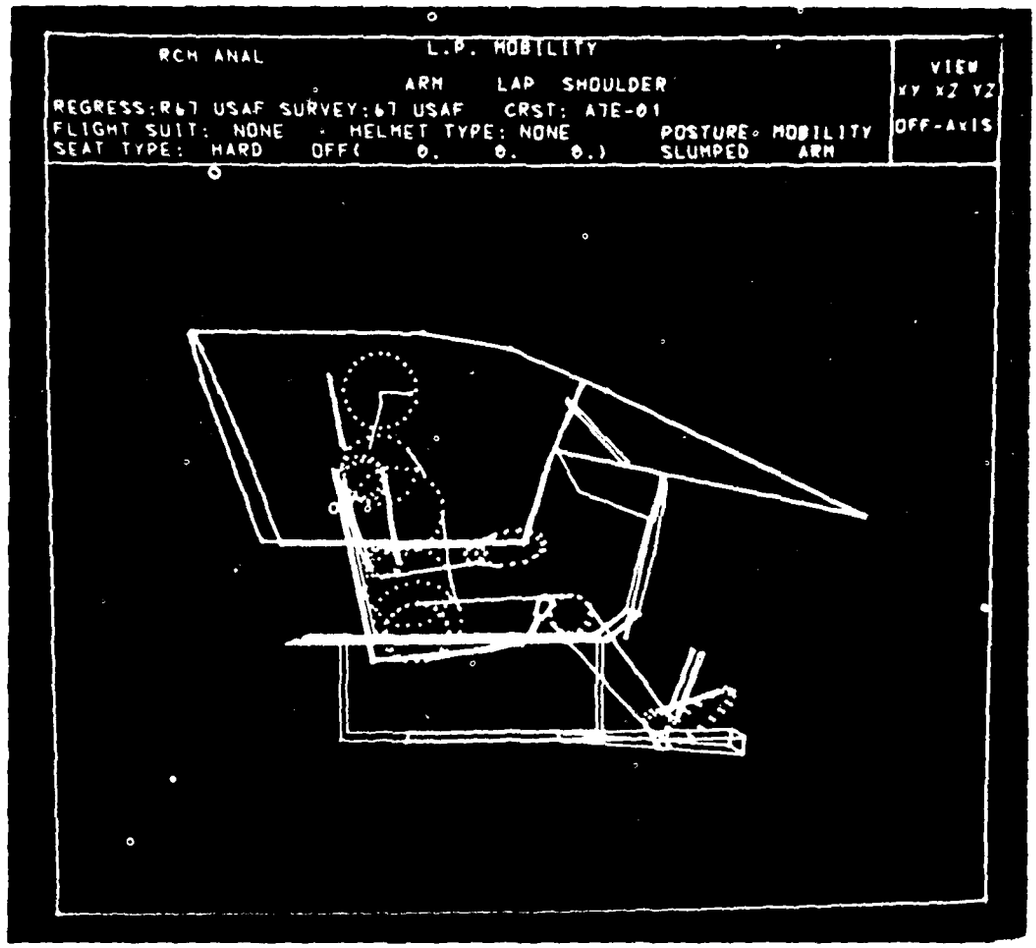

Figure 21a. [illegible] Function, First response "L.P. MOBILITY".

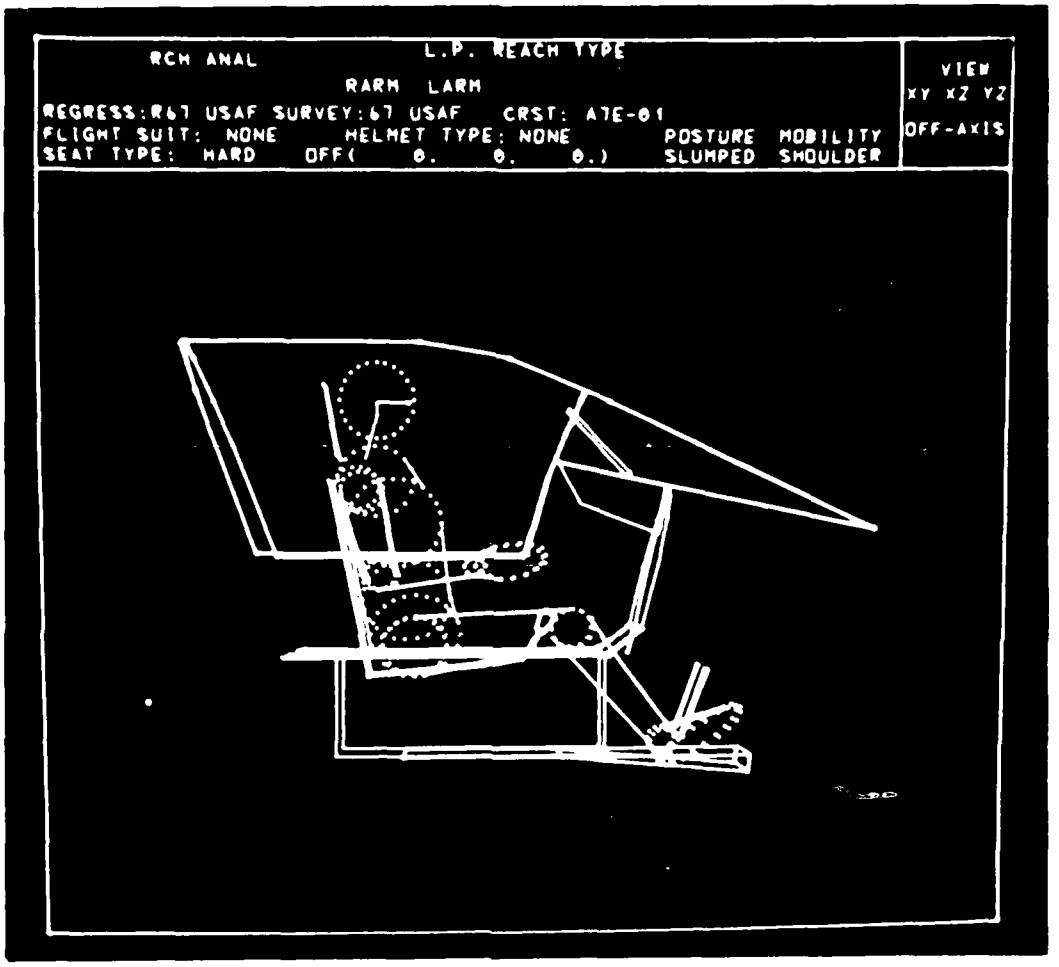

Figure 21b. PERFORM REACH ANALYSIS Function Display - L.P. Reach Type.

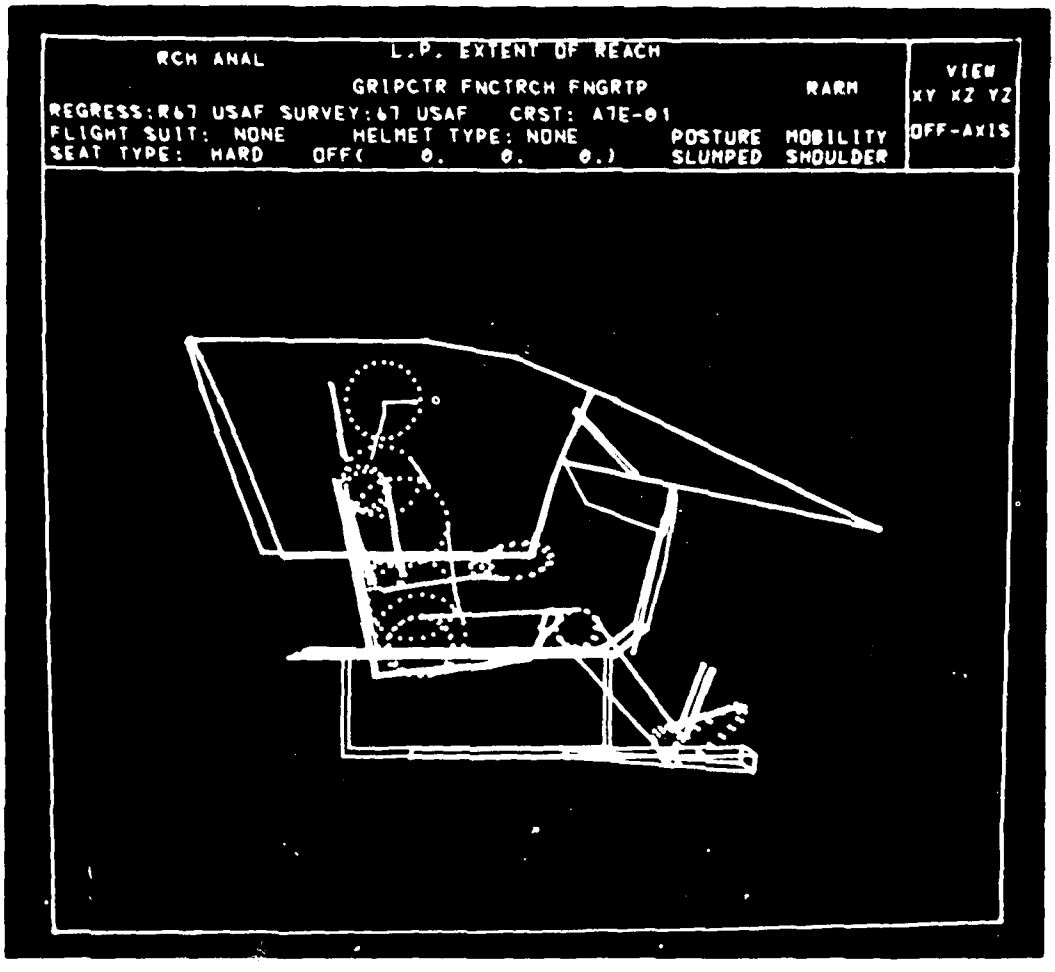
RCH ANAL
L.P. EXTENT OF REACH
GRIPCTR FNCTRCH FNGRTP
RARM
VIEW
XY XZ YZ
REGRESS:R67 USAF SURVEY:67 USAF CRST: A7E-01
FLIGHT SUIT: NONE
HELMET TYPE: NONE
POSTURE
MOBILITY
OFF-AXIS
SEAT TYPE: HARD
OFF(0. 0. 0.)
SLUMPED
SHOULDER

Figure 21c. [illegible]

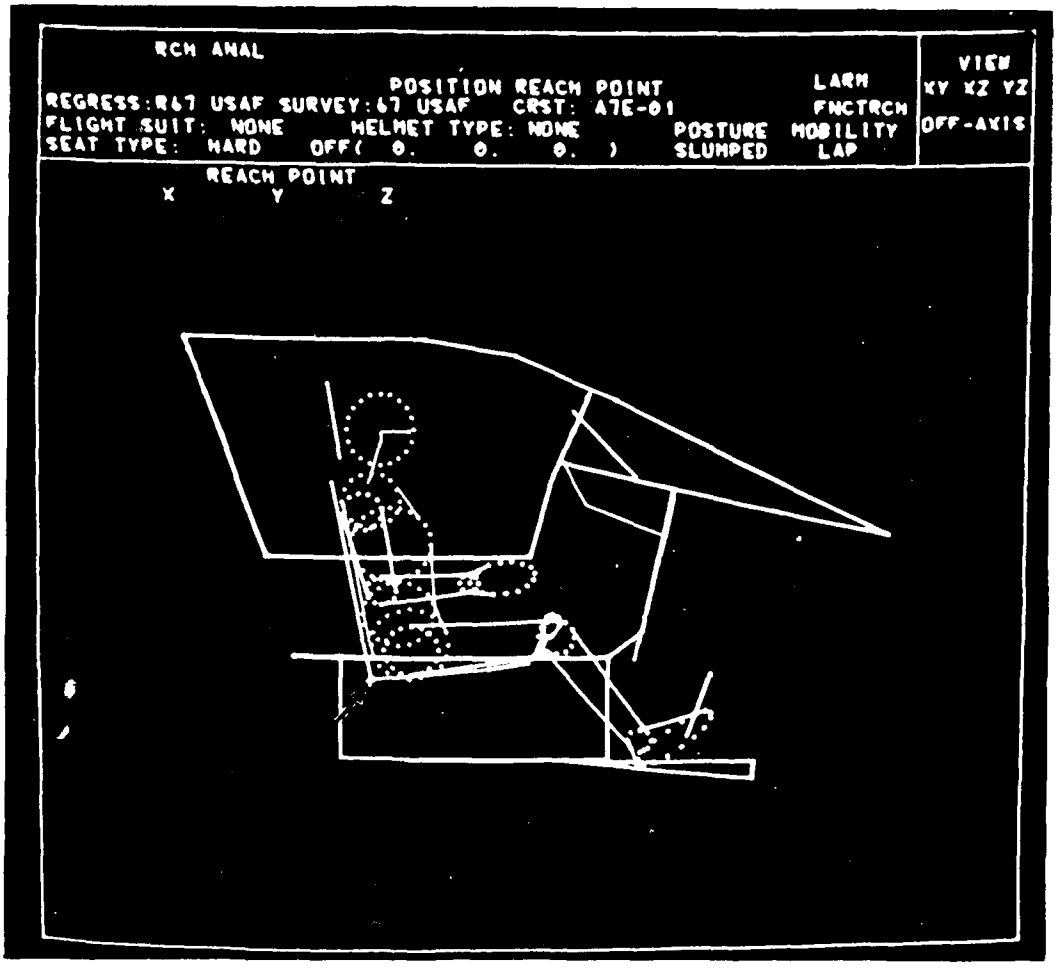

Figure 22. Positioning Cross Symbol [illegible]. Cross Symbol is Displayed [illegible] Shown by the Arrow.

in the Y-Z plane. Figure 23a and 23b show the man-model in the X-Z and Y-Z planes respectively with the "+" at a point to be reached on the instrument panel. Positioning the "+" is achieved using the Program Function Keyboard as described in the following paragraph.

The PFKs are temporarily redefined as shown in Figure 24. Their direction and magnitude of movement are indicated inside the circles representing the PFKs in the figure. By selecting the proper PFK, the "+" can be moved up, down, left, right, or combinations of these, at two different speeds. For example, depressing PFK7 causes the "+" to move up and right in one inch increments at a rate of approximately 25 steps per second.

Once in motion, the direction and/or magnitude of movement of the cross can be changed simply by depressing another directional PFK. The motion may be stopped by depressing the STOP/RECORD key (PFK12) once, or depressing the SINGLE STEP ON key (PFK26). After depressing the STOP key, motion can be continued by selecting any other key. As soon as the cross is near the desired point, depress the SINGLE STEP ON key (PFK26). This stops automatic motion of the cross, allows the cross to be moved in single steps of 0.1 or 1.0 inch each time a directional key is depressed. In this way, the cross may be positioned precisely by (1) monitoring the position of the cross relative to the displayed image, or (2) monitoring the X, Y, Z Coordinate Readout (see Figure 23a) which appears in the upper-left part of the Display Area when this function is in progress. This latter method is to be used when the coordinates of the point are known. Note that these coordinates are in the Seat Reference Point coordinate system. Also note that this is different from the NSRP (Neutral Seat Reference Point) when the SEAT ADJUST function is used to displace the seat.

To locate and enter a 3-D coordinate set proceed as follows:

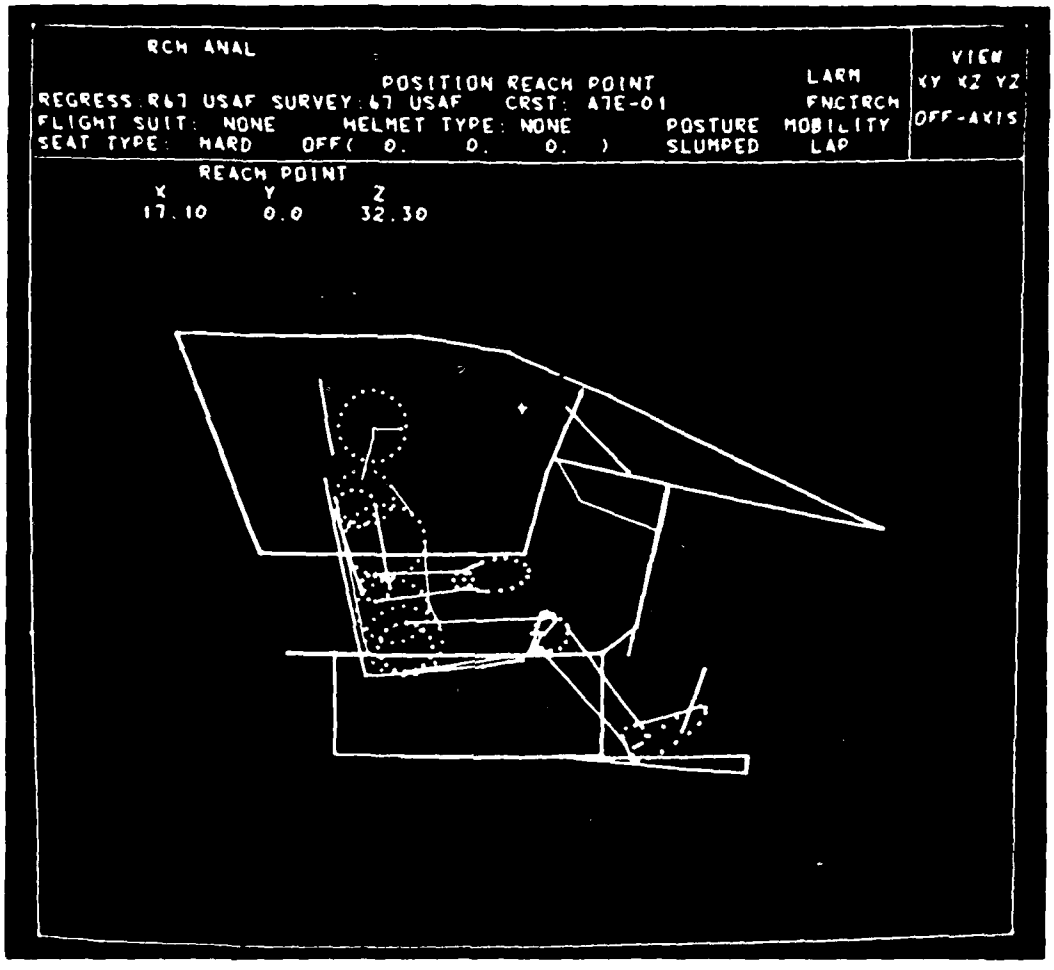

Figure 23a. Side View (X-Z Plane) - the "+" Symbol Locates the Reach Point. The X and Z Coordinates are Defined in this View. Note the Coordinates Displayed in the Upper-Left Hand Display Area.

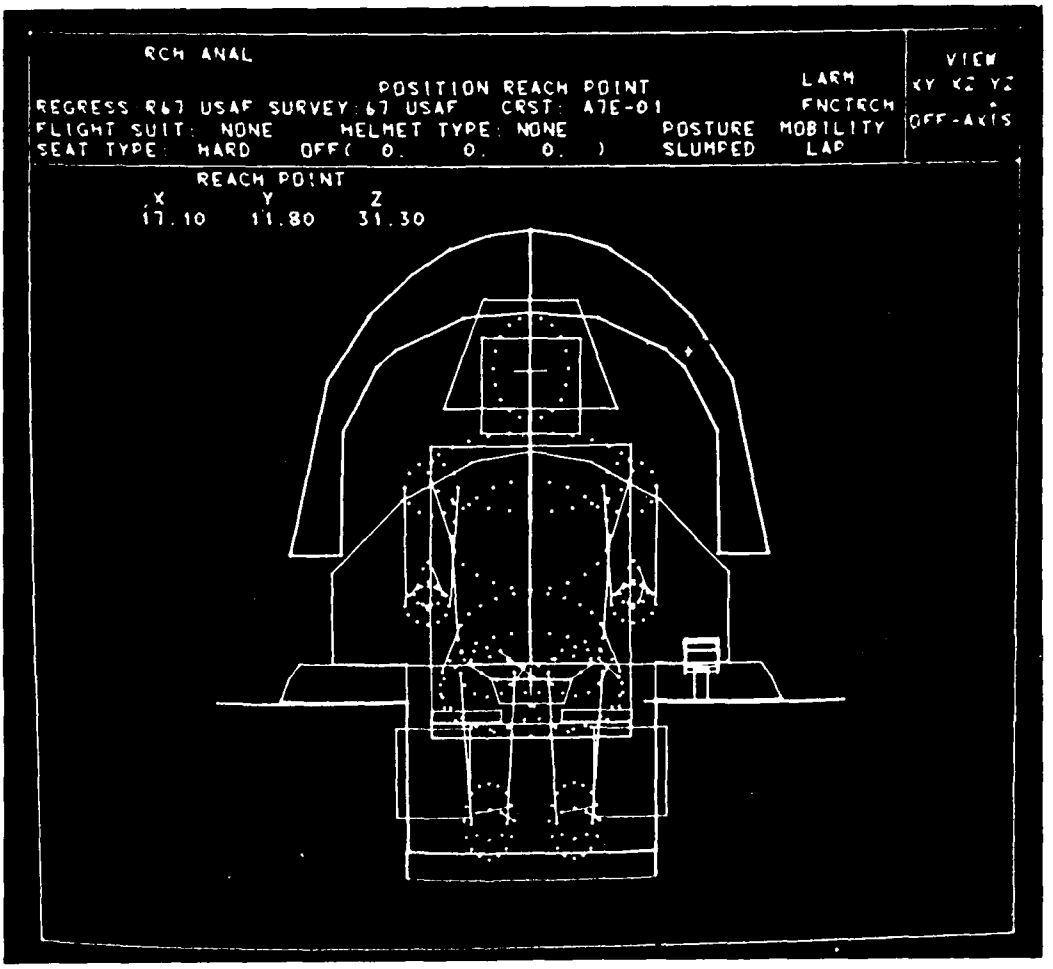

Figure 23b. Front View (Y-Z Plane). The "Cross" Symbol is Used to Define the Y Coordinate. The Z Coordinate May Also be Redefined in this View.

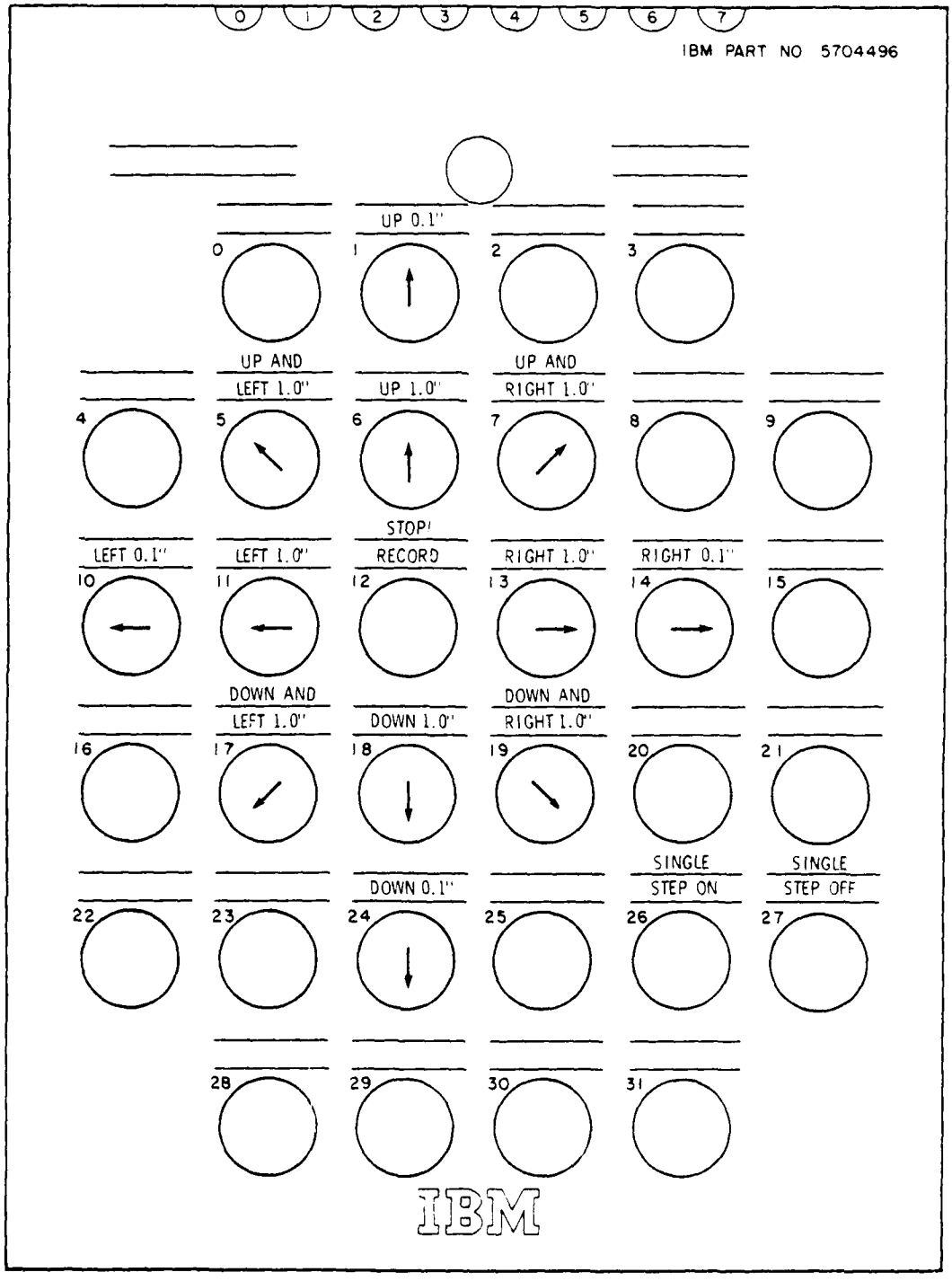

Figure 24. Redefined Program FUNCTION Keys for Positioning the "+" Symbol.

- When the "+" is to be used to locate a point, the display automatically transitions to a side view (XZ plane).
- Move the cross to the desired location in the side view by the method described above.
- Depress the STOP/RECORD key (PFK12) twice in succession to enter the X coordinate.
- The display automatically transitions to a front view (YZ plane).
- Use the left or right direction keys to position the cross in the Y direction.

  NOTE: If the cross is moved up or down, the Z coordinate is redefined.

- Depress the STOP/RECORD key (PFK12) twice in succession to enter the Y and Z coordinates.
- The display automatically transitions to the orientation in use at the time the PERFORM REACH function was activated.

Now the PFKs are reset to their original definition and the man-model begins to reach toward the specified point in three to six discrete steps. When the reach is successful, "REACH SUCCESSFUL" is displayed in the Informational Area of the display (see Figure 25a). If the man-model could not reach the point, the message "MISS DISTANCE" and the miss distance value in inches are displayed in the Information Area of the CRT display (see Figure 25b).

2.2.11.2 Post Reach Processing

Following the reach, the user must lightpen the response "YES" or "NO" to the prompting message "RECORD?" (see Figures 25a or 25b). If the user's response is "YES", a summary of the reach analysis as shown in Figure 26 will be printed out. If the user's response is "NO" there will be no printed output.

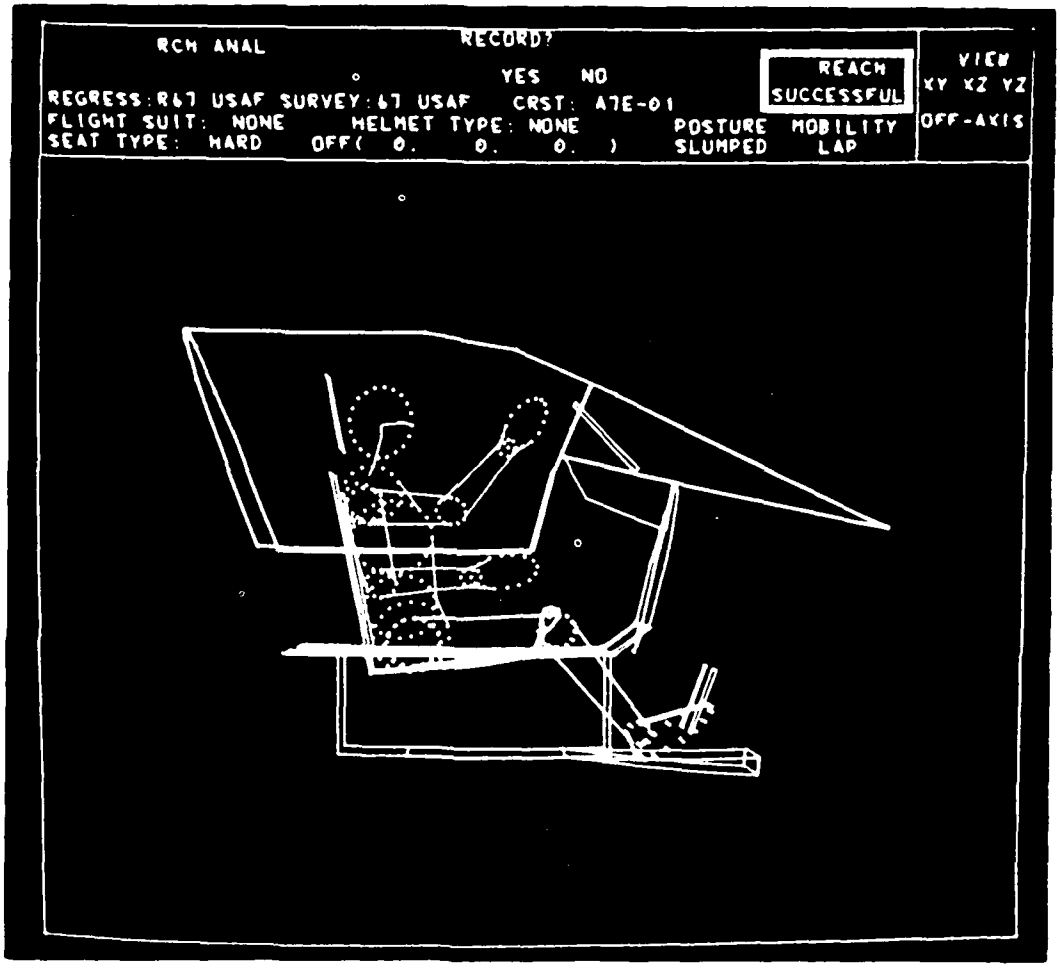

Figure 2-1. REACH operational display when a reach is successfully performed.

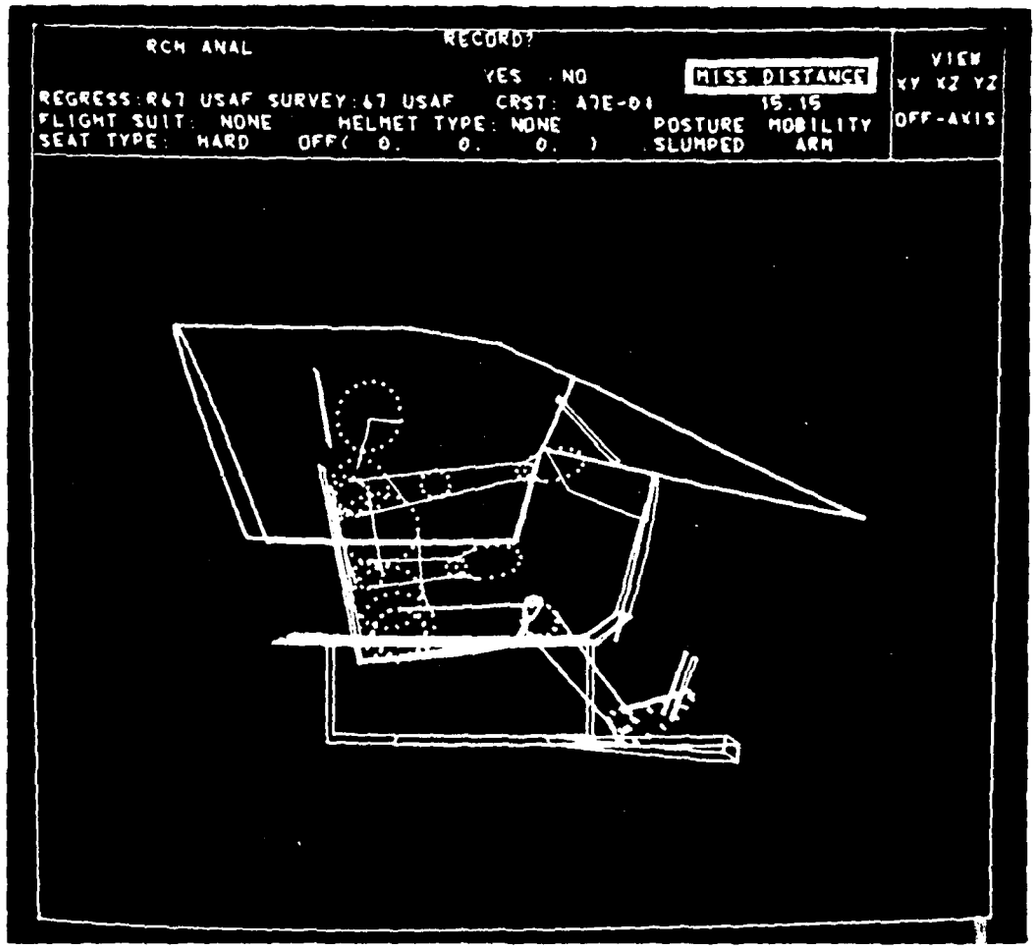

Figure 25b. MISS DISTANCE is Displayed When the Man Model Could Not Reach the Target.

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COMBIMAN REACH ANALYSIS

RCH NO.	RCH TYPE	RCH PT.	DIST. TO RCH PT.	POSTURE	MOBILITY
2	1 LEFT ARM	(28.00, 0.0 , 9.00)	0.00	SEUMPED	LAP

Figure 26. PERFORM REACH Function Printout Obtained When User Responds "YES" to Message "RECORD? L.P. YES or NO".

The message "CONTINUE REACH?" is then displayed in the Prompting Area of the CRT screen. If the user wishes to continue the reach analysis with the same arm or have a two arm reach, he must light-pen "YES". In this case the program will restart the reach routine and will prompt the user to light-pen the reach type (see Paragraph 2.2.11). If the user desires a two arm reach, he must light-pen "LARM" if the first choice was "RARM" and vice versa. When a two arm reach is executed, the first reach determines the position of the shoulder and trunk. The reach by the remaining arm is an "arm only" type of reach, without shoulder or trunk movement. If the user light-pens "NO" the program progresses to display the next message "RESET POSTURE?". If the user light-pens "YES" the program resets the man-model to the posture before the reach attempt. If the user light-pens "NO" the man-model remains in the reaching posture. At this point the reach routine returns control to the main program.

2.2.12 INPUT 12 ANTHROPOMETRIC DIMENSIONS Function (PFK12)

This is one of two methods of defining the body-size of the man-model. The other is described in Paragraph 2.2.13. The INPUT 12 ANTHROPOMETRIC DIMENSIONS function allows the user to supply values, either as percentiles or as absolute dimensions, for each of the dependent anthropometric variables necessary to construct the link system of the man-model. This function can be selected by depressing PFK12.

After PFK12 is depressed, the message "CARD INPUT? (Y/N)" is displayed in the Prompting Area. The user may type in the response "YES" or "Y" to read the 12 anthropometric dimensions from input cards in the format shown in Figure 27. If the response is "NO" or "N" followed by the ALT CODE/5 sequence, or simply the ALT CODE/5 sequence, the message "WILL VALUES BE IN PERCENTILES?" will be displayed in the Prompting Area of the CRT.

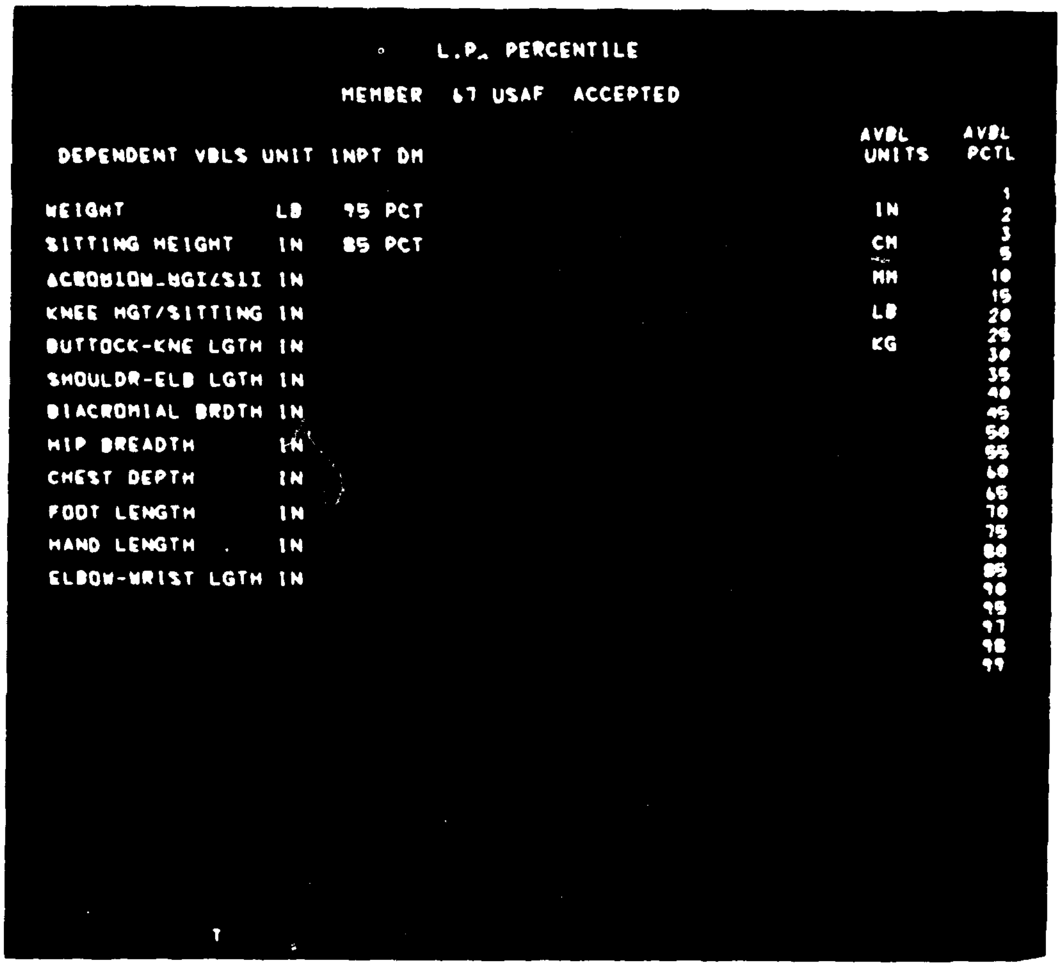
The user must type in "YES" or "Y" as a positive or "NO" or "N" as a negative response to this prompting message. If the response is "YES" or "Y", the user should respond to the prompt "L.P. PERCENTILE" by light-penning the appropriate percentiles for each dependent variable as they are automatically underlined. The first two variables have been thus defined in Figure 28.

If the response is "NO" or "N" (the values will not be percentiles, but engineering units) the values for the 12 units must be keyed in as the 12 variable names are sequentially underlined. The procedure is as follows:

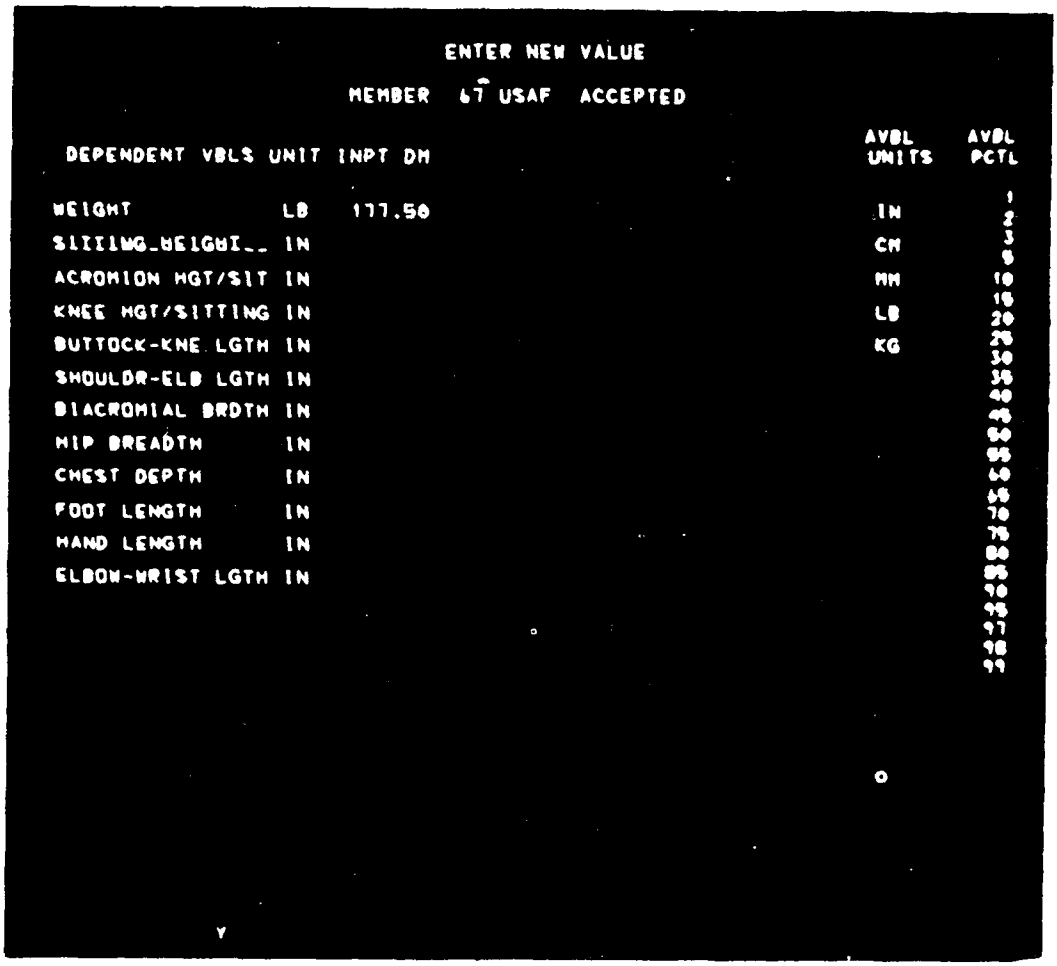
- The first variable name will be underlined, and the message "ENTER NEW VALUE" appears in the prompting area (see Figure 29).
- The user types in the numeric quantity. This is followed by ALT-CODE/5 sequence to enter the value.

```
128.034.5722.8420.7523.0314.2115.9112.409.02 10.087.44 11.58
140.035.8323.3923.0724.6516.1815.9513.986.82 11.307.84 12.63
147.034.2921.6920.4722.6 12.4415.2013.509.61 9.92 7.13 10.90
152.035.6324.1320.8723.2314.4515.4713.159.80 10.837.36 11.50
159.035.7924.4121.6124.0614.6115.5113.749.33 10.167.40 11.99
164.037.0924.6521.6523.5813.8616.3413.359.76 10.397.52 11.58
172.038.1529.2022.1724.7613.9016.8113.789.41 10.557.36 11.58
181.038.2724.9222.8324.6514.4917.4413.7410.9110.517.68 12.01
187.037.3023.7023.1925.8314.8816.3014.379.57 11.308.19 12.87
196.037.0524.4122.5625.5914.5317.0915.0 10.5910.877.99 12.19
202.036.0223.4724.8426.7715.0416.5415.5510.7111.508.23 12.04
211.036.1424.3022.0924.8814.7617.1314.8011.6511.187.72 11.97
221.039.0226.0222.6025.3515.2016.6914.7210.4310.717.76 11.77
228.039.3325.7922.9925.0 14.4716.4215.3911.0611.307.76 12.99
145.033.9421.3420.3522.7612.9915.8312.959.02 9.65 6.93 10.39
149.034.2521.4621.1023.2713.7015.5913.0310.5110.127.24 11.34
163.034.6922.3621.6123.7413.7816.3013.709.88 9.21 7.01 11.30
164.035.1223.1920.3222.3613.9016.0613.9810.1210.477.28 10.91
150.035.3922.8019.6521.2613.2715.9113.079.57 10.287.09 10.71
140.035.8323.3923.0724.6516.1815.9513.986.82 11.307.84 12.64
175.036.1824.6520.7123.4314.6916.0614.3310.1210.0 7.32 11.65
179.036.6524.2921.3423.9013.9815.9514.6110.6710.477.13 11.77
171.037.1723.1522.1323.3514.2116.7714.6510.1210.957.66 11.44
173.037.5224.3022.8724.2914.7617.8014.029.84 10.718.07 12.24
188.037.9925.3223.2324.8015.0 16.3014.4110.2810.957.60 12.60
177.038.3524.6922.7625.5915.4315.8713.908.98 11.187.95 11.81
172.038.8225.3922.8724.9215.2017.3214.659.88 11.147.64 11.53
160.039.2926.1422.6823.1114.5316.8912.878.39 11.027.87 11.93
184.039.6125.2023.2324.6514.8416.3813.709.21 11.267.64 12.07
183.035.1222.5621.3822.6 13.7814.5313.278.03 10.327.56 11.46
```

Figure 27. DATA SET - COMBIMAN.SMPLANTH (Card Image). Each Card Contains 12 Independent Anthropometric Variable in F5.2 Format to Create a Man-Model.



[illegible] Light Pen Percentile Values for the [illegible] ANTHROPOMETRIC [illegible] The first two values have been [illegible] percentiles; the third [illegible] indicating its value will be [illegible] selected percentile value.


ENTER NEW VALUE
MEMBER 67 USAF ACCEPTED
DEPENDENT VBLS UNIT INPT DM
AVBL UNITS
AVBL PCTL
WEIGHT LB 177.50
SITTING_HEIGHT_ IN
ACROMION HGT/SIT IN
KNEE HGT/SITTING IN
BUTTOCK-KNE LGTH IN
SHOULDR-ELB LGTH IN
BIACROMIAL BRDTH IN
HIP BREADTH IN
CHEST DEPTH IN
FOOT LENGTH IN
HAND LENGTH IN
ELBOW-WRIST LGTH IN
IN
CM
MM
LB
KG

- Next the user must identify the units of measure for the quantity entered in the previous step.

  NOTE: Since these units are declared for each number entered, the numbers need not be in the same units, that is, inches, centimeters, and millimeters; and pounds and kilograms. These units may be mixed as desired. After the quantity is entered, the prompt "L.P. NEW UNIT, IF DESIRE" appears. The user selects the appropriate unit of measure with the light pen. Alternatively, since pounds and inches are the default units of measure, the user may select these by using the ALT-CODE/5 sequence rather than the light pen.

- These steps are repeated until all 12 variables are defined.

  NOTE: While values may be entered in any units of measure, they are converted to pounds or inches for processing, display, and printouts.

The last message while using this function is "TABLE OF LINK DATA (Y/N)." To scan the table of link data, which includes link names, lengths and transformation angles, and to make changes, the user should type "YES" or "Y" and then depress the ALT-CODE/5 sequence. If not, the user depresses the ALT-CODE/5 sequence. Instructions on changing the contents of the table will be given in Paragraph 2.2.14.

2.2.13 INPUT TWO INDEPENDENT VARIABLES Function (PFK13)

This is one of two methods of defining the size of the man-model. The other is described in Paragraph 2.2.12.

The INPUT TWO INDEPENDENT VARIABLES function gives the user the opportunity to select two relevant anthropometric variables and enter values for each. One of these variables will be highly correlated to the mass variables of the man-model, and the other will be highly correlated to the length variables. One of the advantages of this function is that the user need not have specific values for all twelve dependent anthropometric dimensions, as with PFK12 (Paragraph 2.2.12). Instead, the user can select two key variables most relevant to the design or evaluation problem. The program will calculate values for the remaining dependent variables using regression equations. Values supplied by the user can be either percentiles of the selected anthropometric data base, or engineering units.

After depressing PFK13, the CRT is formatted as shown in Figure 30a. The left and center portions of the screen contain the columns of mass and length related variables, respectively. To the right of each variable name is the default or predefined unit of measurement. The right portion of the screen contains a column of alternative units of measurement, labeled "AVBL UNITS", and a column of percentile names, labeled "AVBL PCTL", for which values can be obtained from the selected survey member.

The program places realistic constraints on the second value entered, so the first value should be the most important one. If the length dimension is more important than the weight, enter it first. Based on the value of the first entry, the second entry is constrained within a certain range (displayed in the information area as shown in Figure 30b). This range is set at $\pm$ 1.65 standard deviations from the best estimate derived from the first value entered. This range can be redefined by the user as follows:

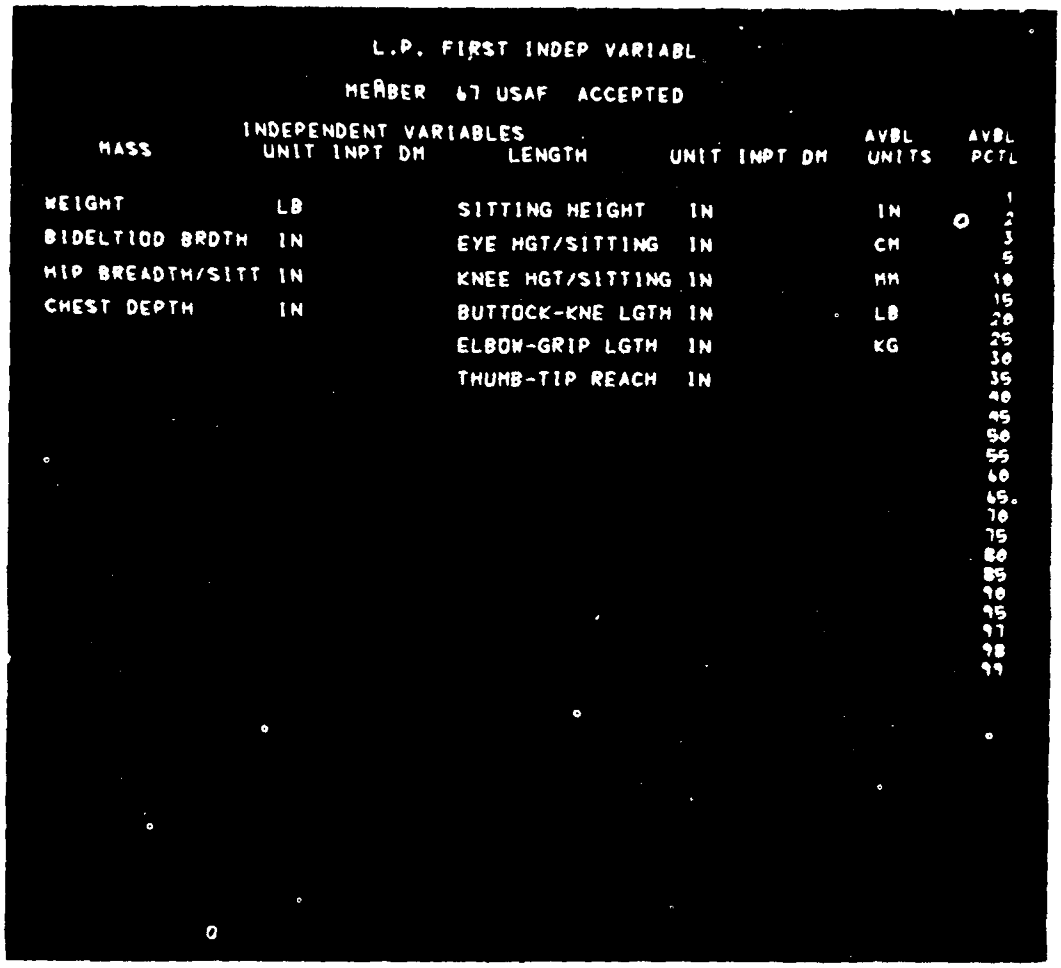


Figure [illegible]. [illegible] Light-Ton, First Independent Variable.

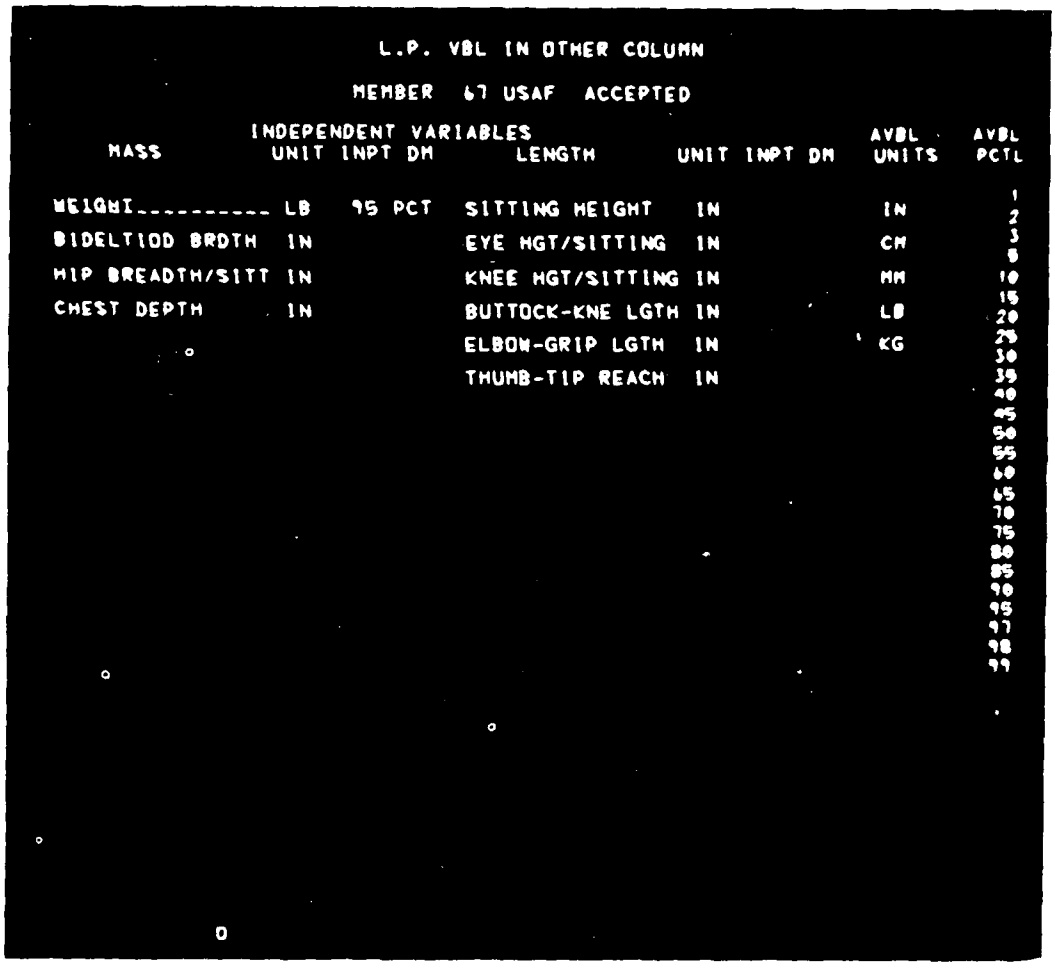


Figure 30b. INPUT TWO INDEPENDENT VARIABLES (Light-Pen Second Independent Variable).

The first prompting message is "ENTER NEW Z-SCORE."[1] This Z-score value is used in the equation which calculates the range of permissible values for the second independent variable selected. If the default value of 1.65 is retained, the permissible range will include approximately 90% of all possible values for the variable. Increasing the Z-score will increase the range; decreasing it will decrease the range. The value the user types in must fall between -3.0 and +3.0. If the default value of 1.65 is suitable, the user may respond by depressing the ALT-CODE/5 sequence. Otherwise, type the new value and enter it by the ALT-CODE/5 sequence.

The next message is "WILL VALUES BE IN PERCENTILES?" If the user's response is "YES" or "Y" or just the ALT-CODE/5 sequence, values will be input by light-penning a percentile from the column "AVBL PCTL" (see Figure 30c). If the response is "NO" or "N", values for the selected variables will be entered in Engineering units using the alphanumeric keyboard. For values to be input as percentiles, Table 1 shows the sequence of displayed messages and user responses to be followed. If the values are supplied through the alphanumeric keyboard, the user should use Table 2 as a guide to the sequence of system messages and user responses. Once the independent values are supplied, the program calculates the surface dimensions required to construct the link system of the man-model. These dimensions are calculated using multiple regression equations from the selected regression member with the user supplied dimensions.

The last message while using this function is "TABLE OF LINK DATA (Y/N)." To scan the table of link data, which includes link names, lengths and transformation angles, and to make changes, the user should type "YES" or "Y" and then depress the ALT-CODE/5 sequence. If not, the user depresses the ALT-CODE/5 sequence. Instructions on changing the contents of the table will be given in Paragraph 2.2.14.

---

[1] Z-score represents the extent to which an individual value falls above or below the mean of a set of data.

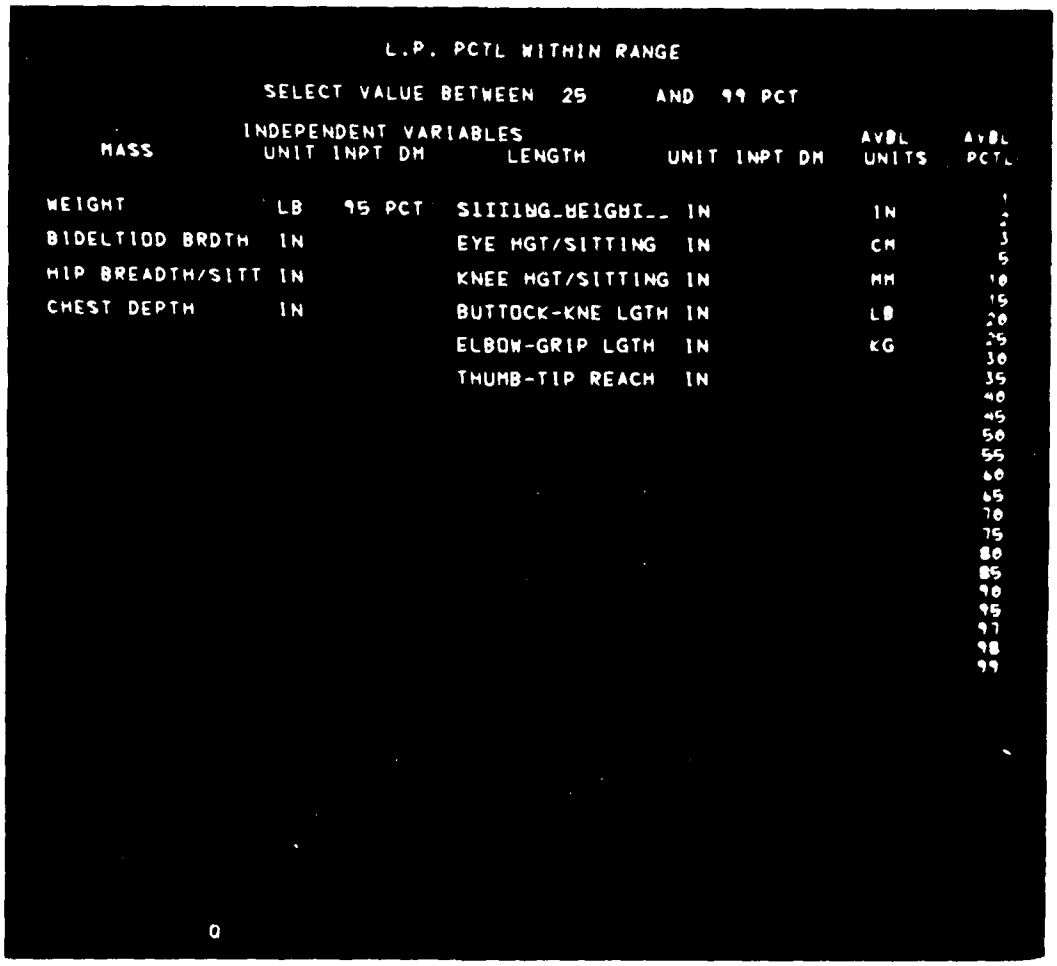


Figure 30c. INPUT TWO INDEPENDENT VARIABLE [illegible]. Light-Pen Percentile for the Second Independent Variable Within Range.

TABLE 1

PROGRAM MESSAGES AND USER RESPONSES FOR PFK13
WHEN VALUES WILL BE INPUT AS PERCENTILES

(Program Responses Are Listed in Parenthesis)

PROGRAM MESSAGES	USER RESPONSES
L.P. FIRST INDEP. VARIABLE	Light pen a variable from either mass or length column. See Figure 30a. (Selected variable will be underlined by program.)
L.P. PERCENTILE	Light pen percentile number from the column "AVBL PCTL". (Selected percentile will be displayed next to underlined variable.)
L.P. VBL IN OTHER COLUMN	Light pen a variable from the column not selected the first time. See Figure 30b. (Selected variable will be underlined, if it is in the other column, and a permissable range of percentile values will be displayed in the information area.)
L.P. PCTL WITHIN RANGE	Light pen a percentile number from the column "AVBL PCTL" which lies within the range of values displayed. See Figure 30c. (Selected percentile will be checked and displayed next to underlined variable.)

TABLE 2

PROGRAM MESSAGES AND USER RESPONSES FOR PFK13 WHEN VALUES WILL BE INPUT AS ABSOLUTE DIMENSIONS

(Program Responses Are Listed in Parenthesis)

PROGRAM MESSAGES	USER RESPONSES
L.P. FIRST INDEP. VARIABLE	Light pen a variable from either mass or length column. (Selected variable is underlined)
ENTER NEW VALUE	Type in real number value via the alphanumeric keyboard, followed by the ALT-CODE/5 sequence. (Typed value will be displayed next to underlined variable.)
L.P. NEW UNIT, IF DESIRED	If a unit of measurement other than the one listed next to the underlined variable is desired, light pen a new unit from the column "AVBL UNITS". If no change is desired, press ALT-CODE/5 sequence. The system checks that the unit is valid for the type of variable and displays it next to the input value. It also checks for the value to be within range for the selected survey.
L.P. VBL IN OTHER COLUMN	Light pen a variable from the column not selected the first time. (Selected variable will be underlined if it is in the proper column; a permissible range of absolute values in the preferred unit of the second variable will be displayed in the information area.)
ENTER NEW VALUE	Type in real number value within the displayed range. via the alphanumeric keyboard, followed by the ALT-CODE/5 sequence. (Typed value will be verified and displayed next to underlined variable.)
L.P. NEW UNIT, IF DESIRED	Press ALT-CODE/5 sequence. (Because the permitted range is in the preferred unit of measurement, and the value input must be within that range, it is not possible to change units for the second value at this time.)

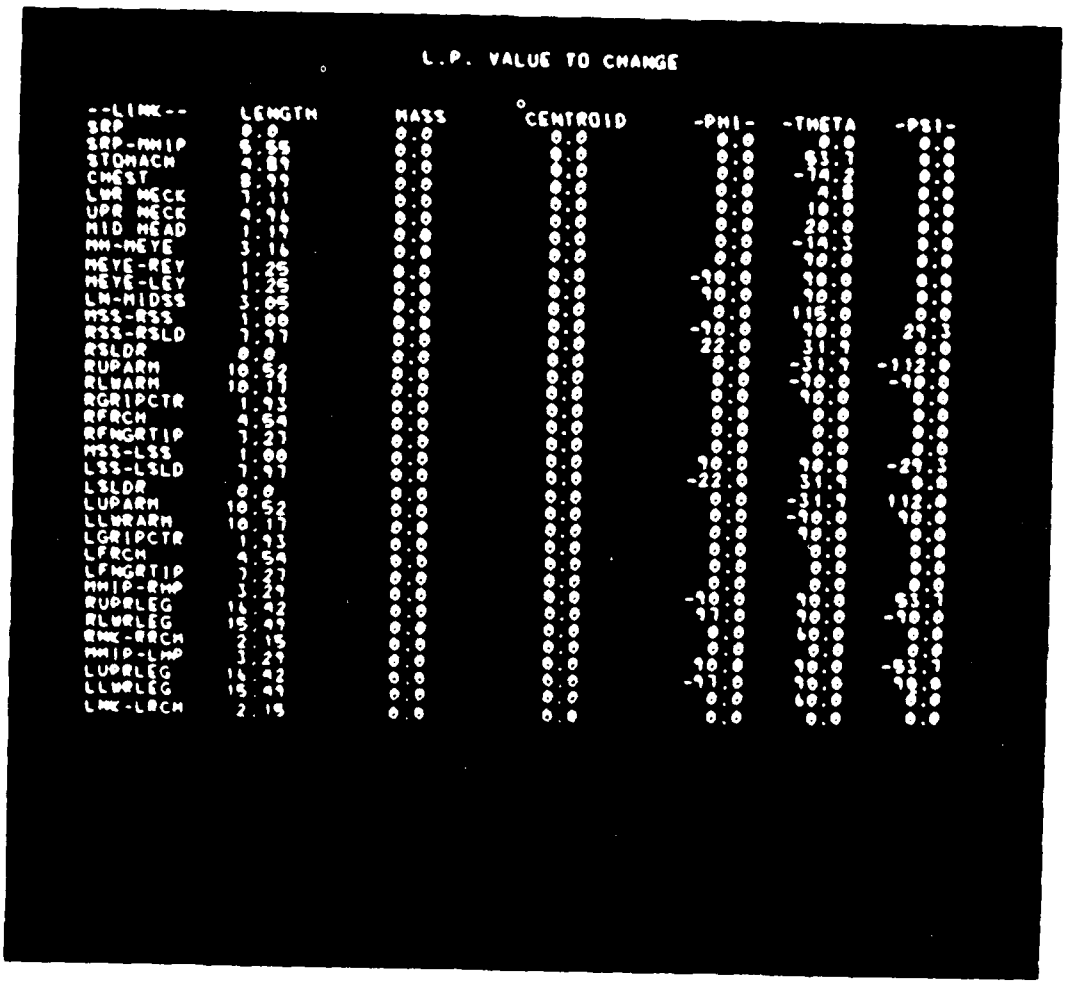
2.2.14 DISPLAY TABLE Function (PFK14)

The DISPLAY TABLE function gives the user the opportunity to inspect the table of link dimensions and angles and make changes to any or all of the values, if necessary. Since the table displays internal link lengths, the anthropometry of the man-model should be defined prior to using this function. Figure 31a shows an example of a Display Table.

The user can modify the values in the Display Table by light-penning the value to be changed, typing a new value, and depressing ALT-CODE/5 (see Figure 31b). When all changes are made the user depresses ALT-CODE/5 again. The transformation angles in this display can be modified to place the man-model in any desired position (see Paragraph 2.2.20).

Other than the choices of slumped or erect posture, and the reposturing in the reach analysis, using the LINK TABLE to change the joint angles is the user's most important method to change the body position of the man-model. To properly use this table refer to Table 3 for all link definitions.

As described in Section 1, the link system is a series of vectors added together. Each link vector has a local coordinate system with its origin at the distal end. The orientation of the next distal link is defined in this local coordinate system. The Phi, Theta, and Psi correspond to Euler angles as shown in Figure 32. Since these local coordinate systems are usually not aligned with the base system, no rule can be given for selecting a particular direction of movement. The user should try angular changes one-by-one to verify desired results.


L.P. VALUE TO CHANGE
--LINK--
LENGTH
MASS
CENTROID
-PHI-
-THETA
-PSI-
SRP
SRP-MMIP
STOMACH
CHEST
LWR NECK
UPR NECK
MID HEAD
MM-MEYE
MEYE-REY
MEYE-LEY
LM-MIDSS
MSS-RSS
RSS-RSLD
RSLDR
RUPARM
RLWARM
RGRIPCTR
RFRCH
RFNGRTIP
MSS-LSS
LSS-LSLD
LSLDR
LUPARM
LLWRARM
LGRIPCTR
LFRCH
LFNGRTIP
MMIP-RMP
RUPRLEG
RLWRLEG
RMK-RRCH
MMIP-LMP
LUPRLEG
LLWRLEG
LMK-LRCH

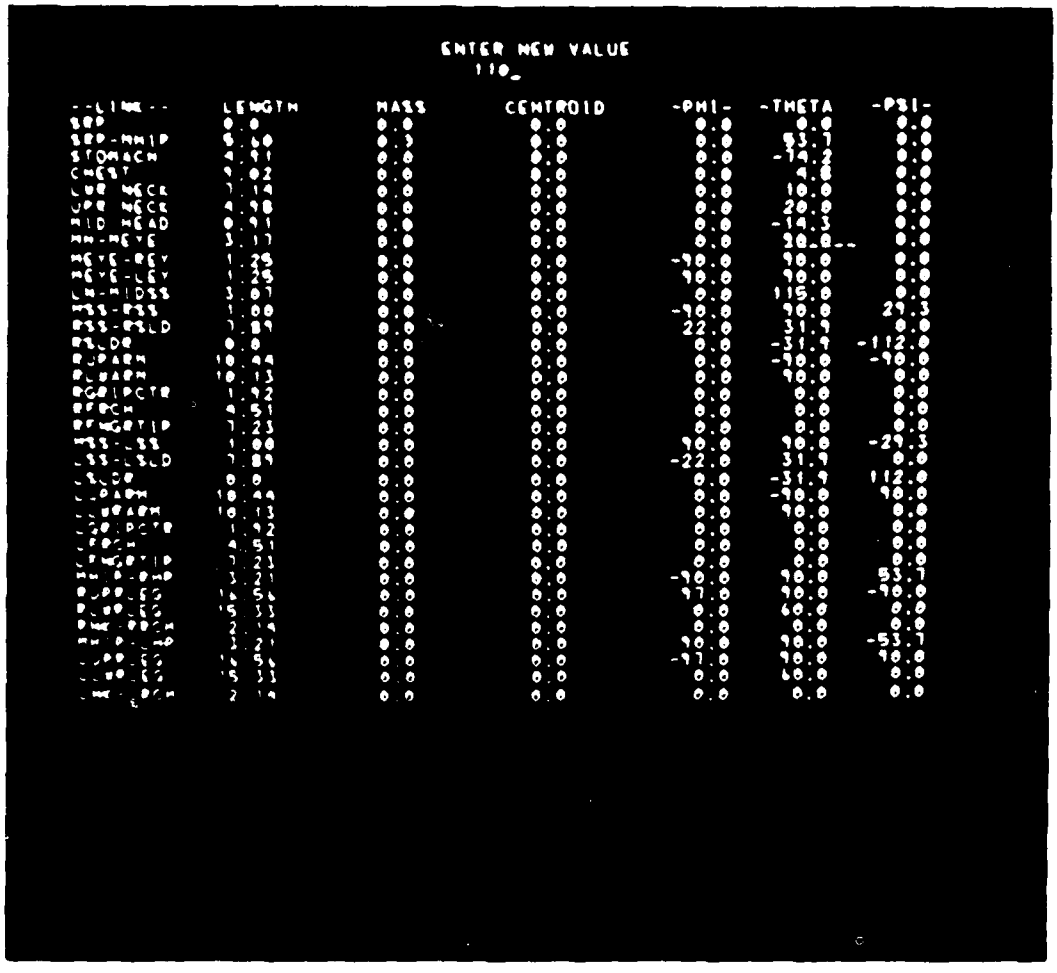


Figure 31b. DISPLAY TABLE Change THETA Value of MI-M11 from 90° to 110°.

TABLE 3

LINK SYSTEM DEFINITION

LINK NO.	NAME	DEFINITION
0	SRP	Zero-length link at the SRP
1	SRP-MHIP	SRP to mid-hip
2	STOMACH	Mid-hip to L3/L4 disc
3	CHEST	L3/L4 disc to T8/T9 disc
4	LWR NECK	T8/T9 disc to T1 vertebra
5	UPR NECK	T1 vertebra to atlas
6	MID HEAD	Atlas to mid-head point
7	MH-MEYE	Mid-head point to mid-eye point
8	MEYE-REY	Mid-eye point to right eye
9	MEYE-LEY	Mid-eye point to left eye
10	LN-MIDSS	T1 vertebra to mid-suprasternale
11	MSS-RSS	Mid-suprasternale to right suprasternale
12	RSS-RSLD	Right suprasternale to right shoulder
13	RSLDR	Zero-length link at the right shoulder
14	RUPARM	Right shoulder to right elbow
15	RLWARM	Right elbow to right wrist
16	RGRIPCTR	Right wrist to grip center point
17	RFRCH	Right grip center point to functional reach point
18	RFNGRTIP	Right functional reach point to fingertip reach point
19	MSS-LSS	Mid-suprasternale to left suprasternale
20	LSS-LSLD	Left suprasternale to left shoulder
21	LSLDR	Zero-length link at the left shoulder
22	LUPARM	Left shoulder to left elbow
23	LLWRARM	Left elbow to left wrist
24	LGRIPCTR	Left wrist to grip center point
25	LFRCH	Left grip center point to functional reach point
26	LFNGRTIP	Left functional reach point to fingertip reach point
27	MHIP-RHP	Mid-hip to right hip
28	RUPRLEG	Right hip to right knee
29	RLWRLEG	Right knee to right ankle
30	RNK-RRCH	Right ankle to bottom of the right foot
31	MHIP-LHP	Mid-hip to left hip
32	LUPRLEG	Left hip to left knee
33	LLWRLEG	Left knee to left ankle
34	LNK-LRCH	Left ankle to bottom of left foot

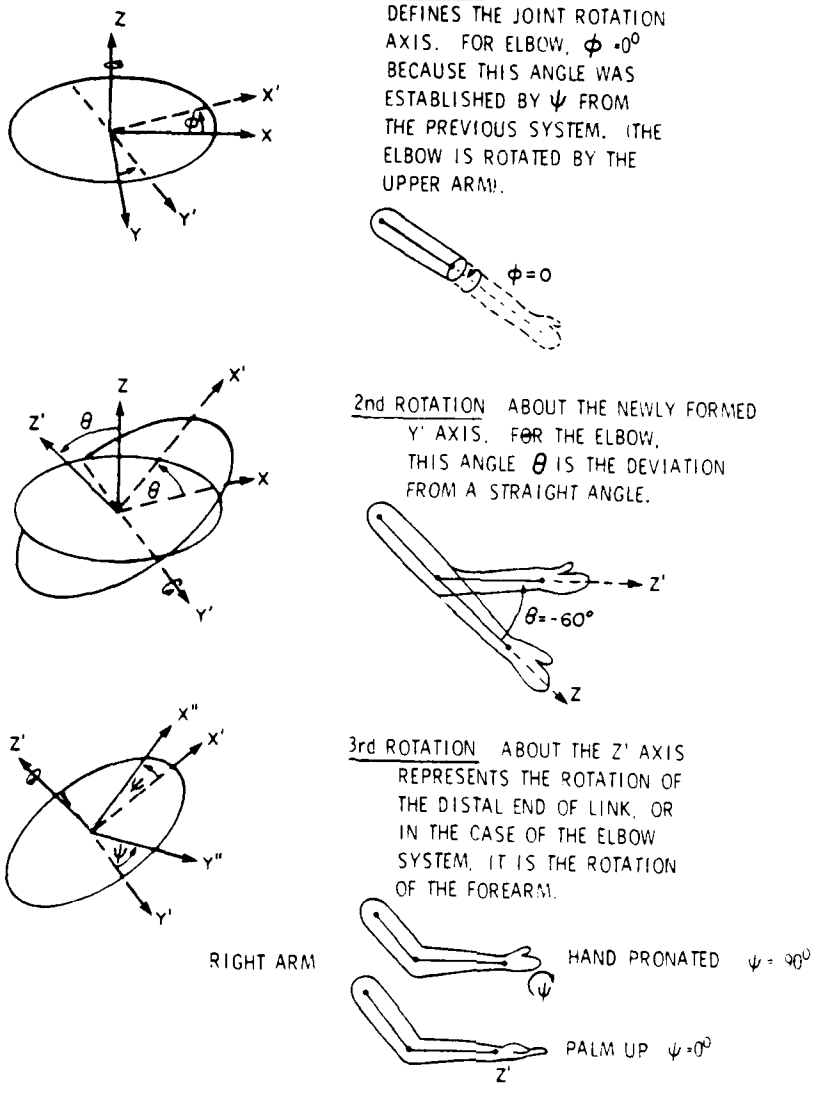


Figure 32. Example of Euler Angle Changes for Elbow Joints.

2.2.15 DESIGN PANEL Function (PFK16)

The DESIGN PANEL function allows the user to add a panel to an existing crew station, or design a new crew station by assembling a series of new panels.

In response to prompting message "ENTER PANEL NAME" the user must type a panel name of up to eight characters and enter it by ALT CODE/5 sequence. To the prompting message "ENTER PANEL TYPE" the user should enter a type number "1" for general crew station, "2" for seat panel, and "3" for rudder or brake pedal through the ANKB followed by ALT-CODE/5 sequence. Finally as a response to the message "NO. OF VERTICES" the user must supply the number of vertices (maximum of six vertices) for the panel being defined. Then with the cross symbol "+" and the lighted PFKs (see Figure 22), the user defines the vertices of the panel, one at a time, in the X-Z plane and then in the Y-Z plane using the method described in Paragraph 2.2.11.1*.

As mentioned in Paragraph 2.2.11, PFK12 is used to stop the "+" while in motion. When depressed twice consecutively, it implies the final location of the defined vertex. When subsequent vertices are entered, they are automatically connected by lines.

The panel thus defined can be treated like any other panel. It will not, however, be automatically added to the permanent Crew Station Data Base.

The newly designed panel name and coordinates will appear on the printout as shown in Figure 33.

The panel will be erased when the "ERASE" option of the RETRIEVE CREW STATION function is selected again.

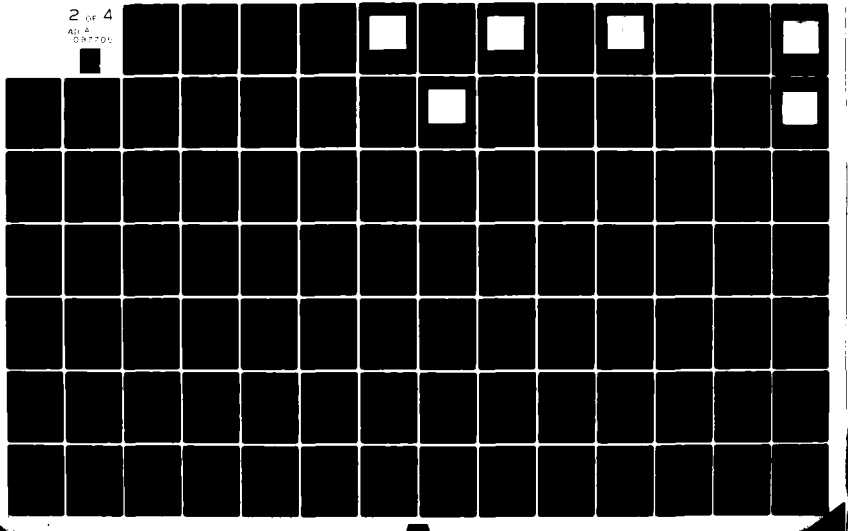
*The program assigns the lowest unused sequence number as the "internal reference number" for this new panel.

```
CBM001I COMBIMAN V., DATE= 2/29/80, TIME=13.11.54.
CBM033I REGRESSION VALUES FROM MEMBER R67 USAF.
CBM015I SURVEY DATA FROM 67 USAF
CBM045I USER CHOOSES TO INPUT 2 INDEPENDENT VARIABLES.
CBM046I INPUT VARIABLES WILL BE IN PERCENTILES.
SITTING HEIGHT         5 PCT               34.700   IN
WEIGHT                 5 PCT              140.150   LB
CBM052I VISIBILITY PLOT GENERATED SUCCESSFULLY.
CBM052I VISIBILITY PLOT GENERATED SUCCESSFULLY.
CBM114I C/S DATA FROM A7--SEAT
CBM114I C/S DATA FROM [illegible]
CBM067I  71.7 NEWPNL   , TYPE= 1, 4 VERTICES
CBM067I 31.00 18.00 16.  31.00 18.00 12.90 31.00 24.00 12.90 31.00 24.00 16.40
CBM073I SWITCH  [illegible]
CBM073I SWITCH 72 ON
CBM033I REGRESSION VALUES FROM MEMBER R67 USAF.
CBM015I SURVEY DATA FROM 67 USAF
CBM045I USER CHOOSES TO INPUT 2 INDEPENDENT VARIABLES.
CBM046I INPUT VARIABLES WILL BE IN PERCENTILES.
SITTING HEIGHT         5 PCT               34.700   IN
WEIGHT                 5 PCT              140.150   LB
CBM002I PROGRAM END.
```

Figure 33. Printed Output of the Newly Designed Panel NEWPNL is Within the Box.

AD-A097 705 DAYTON UNIV OH RESEARCH INST F/G 5/8
USER'S GUIDE FOR COMBIMAN PROGRAMS (COMPUTERIZED BIOMECHANICAL --ETC(U)
JAN 81 P BAPU, S EVANS, P KIKTA, M KORNA F33615-78-C-0507
UNCLASSIFIED UDR-TR-80-44 AFAMRL-TR-80-91 NL

2 OF 4
AD A
097705



2.2.16 DELETE PANEL Function (PFK18)

The DELETE PANEL function allows the user to remove a crew station panel from the display. It does not remove the panel from the Crew Station Data Base. Once deleted, the panel cannot be recalled using the INCLUDE OBJECT function. It must be either recreated by the DESIGN PANEL function, or the entire crew station recalled again using the RETRIEVE CREW STATION function in Paragraph 2.2.6, which resets the crew station to its original configuration.

To delete a panel, the name of the panel must be entered through the alphanumeric keyboard as response to prompting message "ENTER PANEL NAME". If the specified panel does not exist, the program repeats the prompt until the user specifies an existing panel, or signals ALT-CODE/5. If no name is specified by signaling only ALT-CODE/5, the function request is ignored and no deletion occurs. The panel name can be found with the IDENTIFY OBJECT function described in Paragraph 2.2.2.

The DELETE PANEL function is different from the OMIT OBJECT function because this function deletes the panel from the display and cannot be redisplayed by the INCLUDE OBJECT function.

2.2.17 CHANGE PERSPECTIVE Function (PFK22)

The CHANGE PERSPECTIVE function allows the user to change the point of view and/or the effective viewing distance to the displayed man-model and the crew station. This function is useful in enhancing the perspective and therefore the three dimensional character of the displayed image.

To activate the CHANGE PERSPECTIVE function, first depress PFK22. The program displays the message "VIEW ADJUST" and temporarily redefines PFKs 1, 2, 3, 4, 5, 6, and 9 (see Figure 34). If the user depresses PFK9, the message "L.P. NEW CENTER POINT" is displayed. The user may respond by light-penning any desired point in the display. Now the program displays the man-model and the crew station as if looking along the point light-penned. The display is initialized as if the viewing distance is 30 feet away from the screen. This distance may be increased in increments of 10 feet by repeatedly depressing PFK1, or decreased (closer to the screen) in increments of 10 feet by depressing PFK3. This distance increment may be redefined by selecting PFK4, for a 1 foot increment; PFK5, for a 10 feet increment; or PFK6, for a 100 feet increment. However, the upper and lower limits for the effective viewing distance are 10 feet and 1,000 feet respectively.

Depressing PFK9 allows the user to select another view point.

PFK2 terminates the CHANGE VIEW function and returns to the main program, resetting all PFKs to the original definition.

Example: To view the display with respect to the left eye of the man-model, first depress PFK22. Then the PFKs 1, 2, 3, 4, 5, 6 and 9 light up and the message "VIEW ADJUST" is displayed along with the man-model and crew station. Depress PFK9 and respond to the prompting message on the screen "L.P. NEW CENTER POINT" by light-penning the left eye of the man-model. The new display will be along a line with the same horizontal and vertical coordinates as the left eye of the man-model.

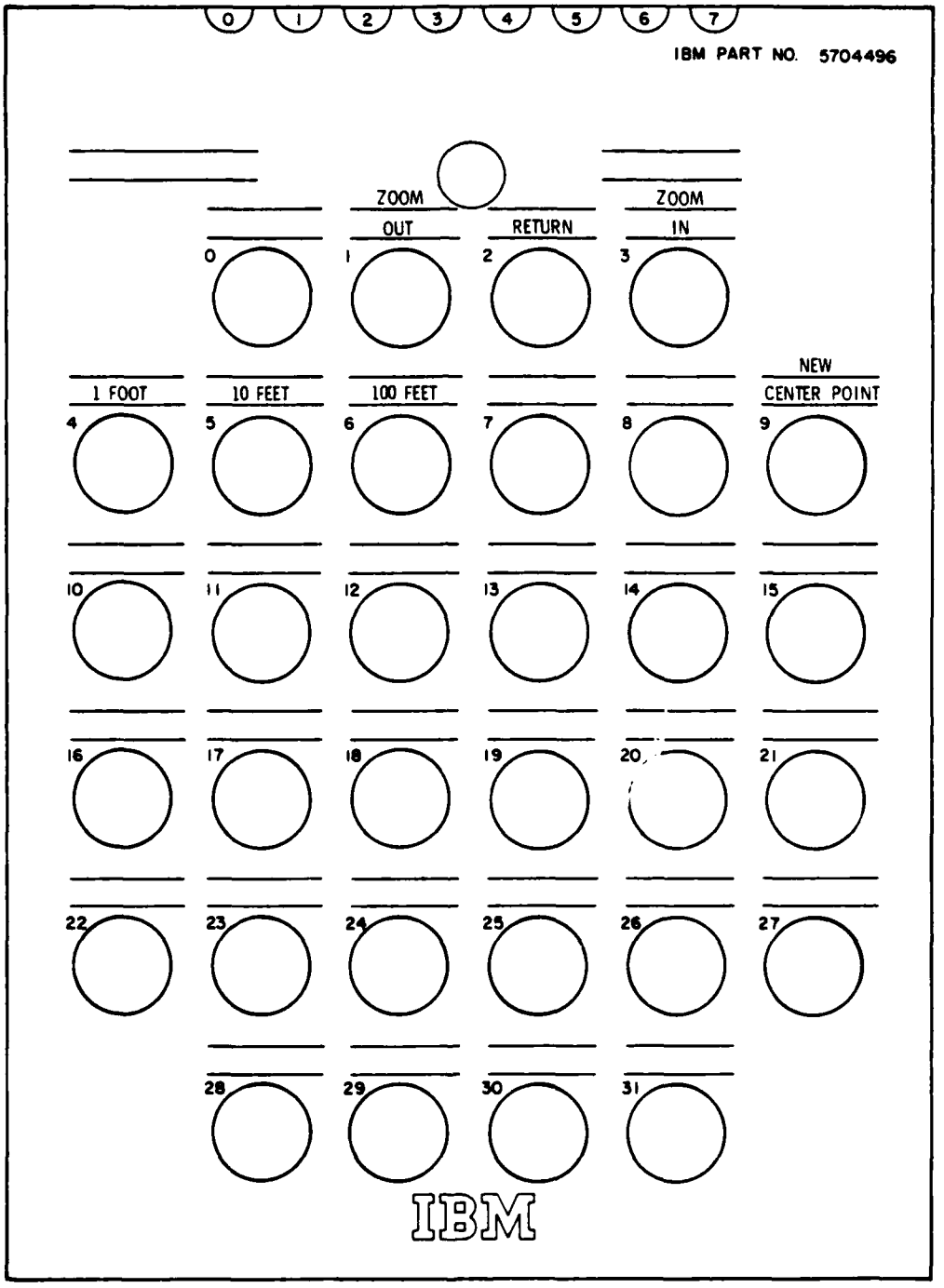


Figure 34. PFK's for Change Perspective Function.

2.2.18 RESET SLUMPED POSTURE Function (PFK23)

The RESET SLUMPED POSTURE function resets the transformation angles of the man-model so that it assumes a slumped posture, as shown in Figure 35. The "slumped posture" is a posture for sitting erect in a seat with a 13° back angle and a 6° seat pan angle. If other postures are desired, the skeletal-link angles may be changed by the method specified in Paragraph 2.2.14, the DISPLAY TABLE function and the RESET PROGRAMMED POSTURE function as described in 2.2.20. This function is commonly used to get back to a starting posture after a reach analysis or a modification of joint angles as described in 2.2.14.

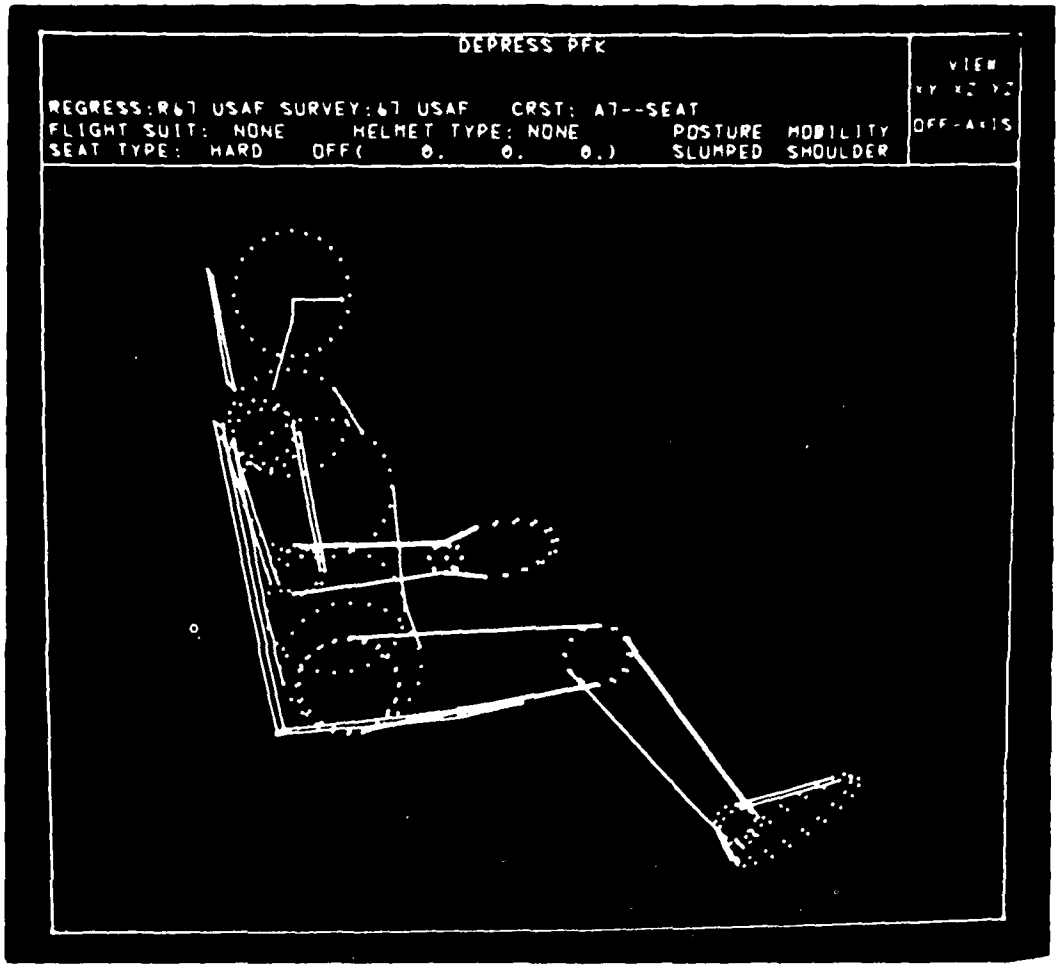


Figure 35. RESET SLUMPED Posture Function.

2.2.19 RESET ERECT POSTURE Function (PFK24)

The RESET ERECT POSTURE function resets the transformation angles of the man-model so that it assumes the standard erect posture as shown in Figure 36.

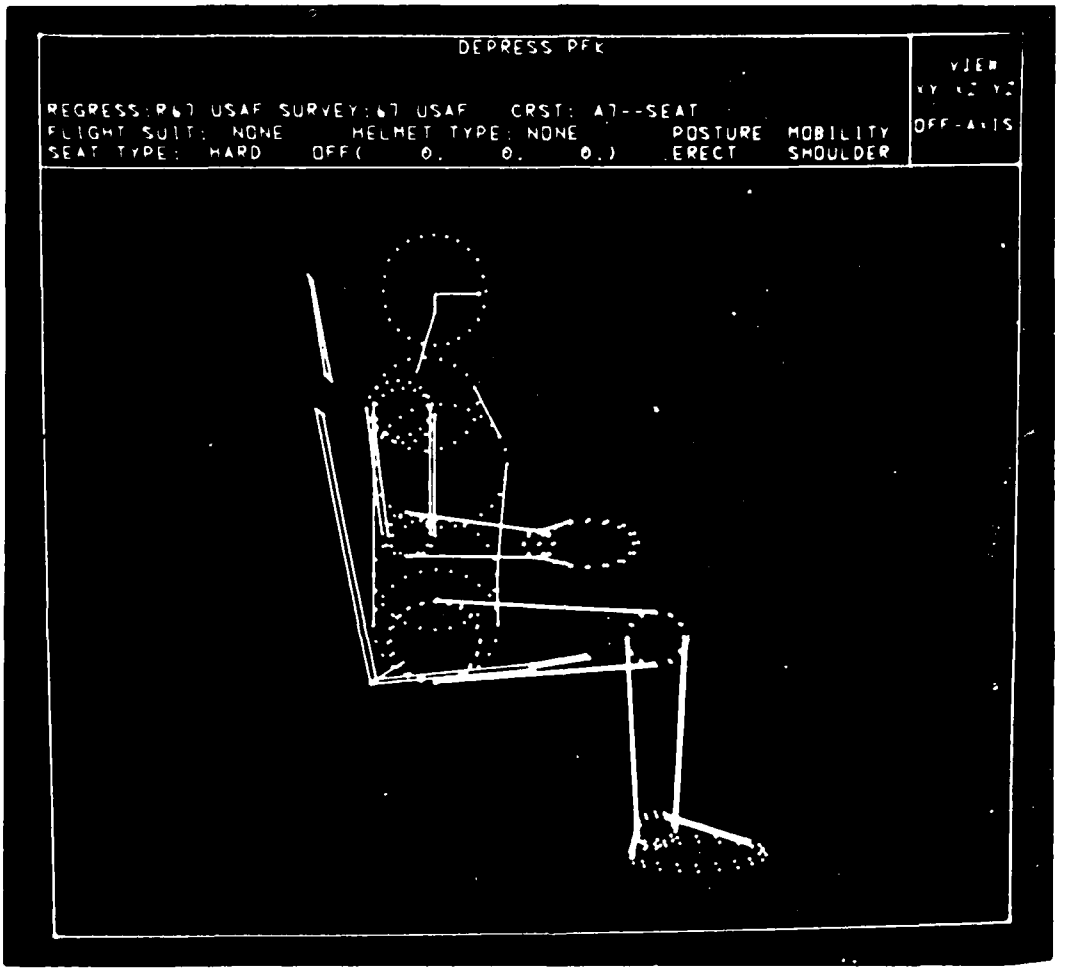


Figure 36. RESET ERECT POSTURE Function.

2.2.20 RESET PROGRAMMED POSTURE Function (PFK25)

The RESET PROGRAMMED POSTURE function resets the transformation angles of the man-model so that it assumes the "Programmed Posture". The "Programmed Posture" is any posture the user desires, which can be achieved by modifying the transformation angles using the DISPLAY TABLE function (see Paragraph 2.2.14). After all changes are made, the new posture of the man-model can be redisplayed at anytime by depressing PFK25 (see Figure 37).

When the program is initialized, the angles for the ERECT POSTURE are automatically entered into this PROGRAMMED POSTURE storage area, so initially pressing the PFK25 merely recalls the ERECT POSTURE. However, anytime the user changes any one or more angles in the link system Display Table, these changed angles are automatically entered into the PROGRAMMED POSTURE storage area. This function may be thought of as a "redisplay" of the last change to the Display Table (See Paragraph 2.2.14).

The angle changes by this function are not stored permanently, and must be redefined every time the user starts or restarts the program.

This function may be used to define a working posture to the user's own specification. Normally, a pilot sits with upper-back and head well forward, causing the eye position to be lowered. Since one posture will not serve all applications, this function allows the user to define and recall any posture.

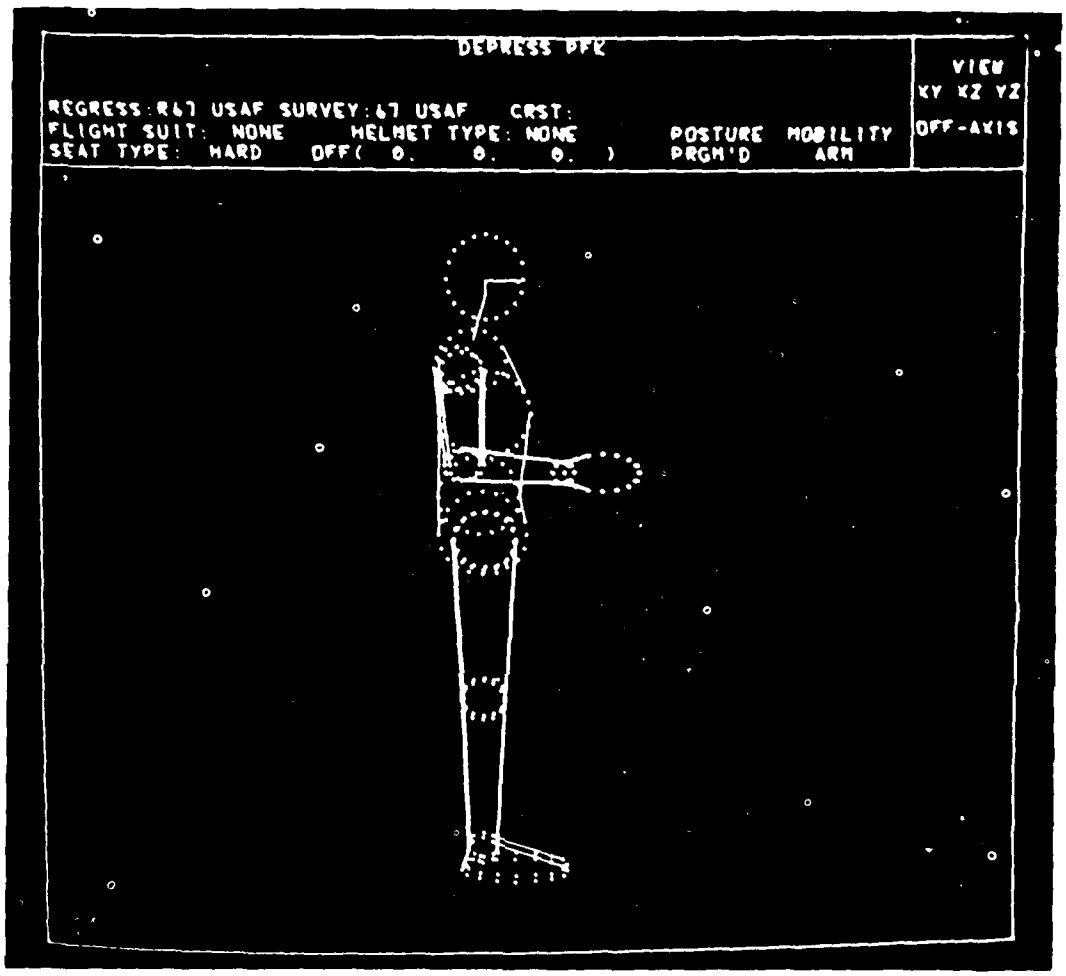


Figure 37. An Example of the Reset Programmed Posture Function.

2.2.21 INCREMENT ROLL, PITCH AND YAW ANGLE Function (PFK26)

The "INCREMENT ROLL, PITCH AND YAW ANGLE" function allows the user to enter a set of roll, pitch and yaw angle increments by which the man-model and crew station are rotated; and a maximum number of iterations desired before the display resets to roll, pitch and yaw angle values of 0.0 degrees. It is similar to a series of "CHANGE VIEW" function (PFK0, described in Paragraph 2.2.1) calls.

This feature allows the user to rapidly rotate the model through a series of discrete steps without taking the time to enter new roll, pitch, and yaw angles using the CHANGE VIEW function. In the default case built into the program, the display assumes a side view with the first selection of PFK26 and on each depression of PFK26 the displayed image rotates -15° in pitch (nose up) and +15° in yaw (left) for six discrete steps, ending with a top view of the displayed crew station. The next depression of PFK26 resets the display to the original side view. The user may pause after any step to make a plot, or select other functions.

The preprogrammed example uses six discrete rotational increments of 0°, -15°, +15° for the roll, pitch and yaw angles. The user may redefine the number of increments or the roll, pitch, and yaw increments in the following manner.

First set State Switch 10 "ON" (see Paragraph 2.2.23). Then depress PFK26 and respond to message "ENTER ROLL ANGLE" by typing the ROLL increment angle in degrees, and entering it by ALT-CODE/5 sequence. Respond to subsequent messages to enter PITCH and YAW angles the same way. The message "ENTER MAX. NO. ITERATIONS" then appears in the Prompting Area of the CRT. The user must then type the number of steps the program should take to reset the man-model from the Alphanumeric Keyboard followed by ALT-CODE/5 sequence.

2.2.22 SEAT ADJUST Function (PFK27)

The SEAT ADJUST function allows the user to off-set the man-model and his seat, if any, with respect to the displayed crew station. This function cannot be activated unless a crew station is displayed on the CRT screen. A seat may or may not be present at the user's option. The default values for this function are X=0, Y=0, and Z=0. After depressing PFK27, the user is prompted to enter the X coordinate or offset. The value in inches is typed using the ANKB and is entered by the ALT-CODE/5 sequence (see Figure 38). If the default value (0 inches) is to be retained, enter the ALT-CODE/5 sequence. The program then prompts the user to enter the Y and Z-coordinates in that order. The user should enter them the same way the X-coordinate is entered. Since the seat may be "adjusted" in three dimensions, this provides a method for placing the man-model (and seat) in different stations in a multi-operator crew station.

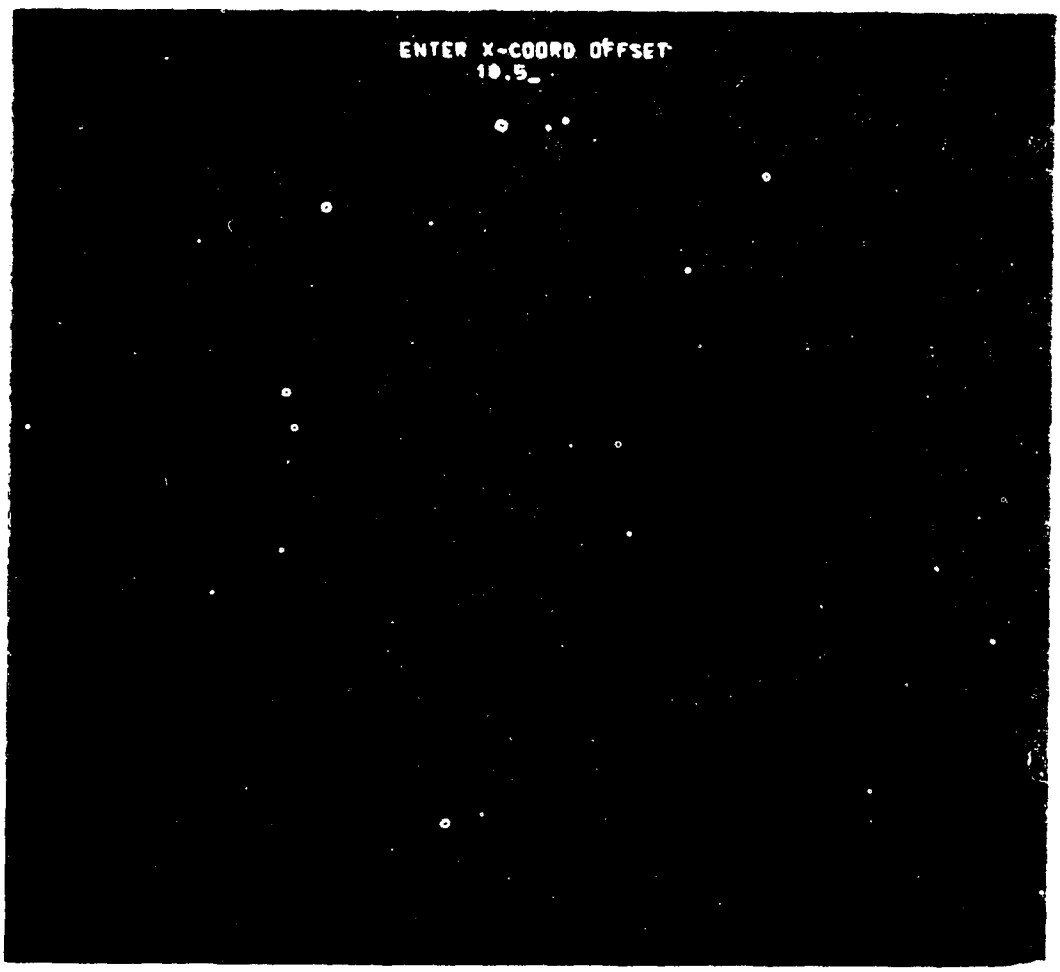


Figure 28. [illegible]
offset in inches.

2.2.23 STATE SWITCH Function (PFK29)

The STATE SWITCH function allows the user to specify the state in which to run the program CBM04. Table 3 shows the various switches available and the meanings of their states.

When this function is selected by depressing PFK29, the message "ENTER SWITCH NUMBER" is displayed. The user may type the switch number followed by the ALT-CODE/5 sequence. Then the message "ENTER ON OR OFF" is displayed. The user must type "ON" or "OFF" followed by the ALT-CODE/5 sequence to invoke the state detailed in Table 4.

TABLE 4

PROGRAM CBM04 USER ACTIVATED STATE SWITCHES

SWITCH NUMBER	IF ON	IF OFF
2	Prints messages CBM0061 and CBM0071 (See Paragraph 2.4).	Messages CBM0061 and CBM0071 suppressed.
3	The entire COMBIMAN link system is displayed.	Only the neck, head, and eye links are displayed.
4	Prints 12 independent anthropometric dimension values.	No printed output.
5	No enfleshment on man-model. (Link system only).	Enfleshed man-model is displayed.
6	Print surface dimensions and internal links as calculated. (As in Figures 39a and 39b.)	Suppress printing of surface and link length data.
10	Reset default conditions when PFK26 activated for roll, pitch, and yaw angles.	Use default conditions for PFK26.
72	Matrices (link) printed, as shown in Figure 40.	No printed output.

COMBIMAN LINK DATA

REFERENCED SURVEY OF REGRESSION EQUATIONS IS R67 USAF
REFERENCED SURVEY OF ANTHROPOMETRIC DIMENSIONS IS 67 USAF

NO.	LINK NAME	LENGTH	REF. ANTH. DIM.	A-LENGTH	A-OFFSET	B-LENGTH	B-OFFSET	C-LENGTH	C-OFFSET
0	SRP	0.0		0.0	0.0	0.0	0.0	0.0	0.0
1	SRP-MHIP	5.47	BUTTOCK-KNEE LGTH	4.222	-0.903	6.831	0.0	4.222	0.430
2	STOMACH	4.03	ACROMION HGT/SET	3.880	0.370	5.464	0.0	3.880	0.048
3	CHEST	8.97	SITTING HEIGHT	4.375	1.696	5.961	0.0	4.375	-0.527
4	LWR NECK	7.69	SITTING HEIGHT	3.176	0.161	7.688	0.0	3.176	-2.012
5	UPR NECK	4.94	SITTING HEIGHT	0.0	0.0	0.0	0.0	0.0	0.0
6	HEAD HEAD	1.33	SITTING HEIGHT	3.678	0.0	2.880	0.0	4.233	0.340
7	SGT-MEYE	3.16	SITTING HEIGHT	0.0	0.0	0.0	0.0	0.0	0.0
8	MEYE-MEY	1.25		0.0	0.0	0.0	0.0	0.0	0.0
9	MEYE-LEY	1.25		0.0	0.0	0.0	0.0	0.0	0.0
10	LS-MIDSS	3.05	SITTING HEIGHT	0.0	0.0	0.0	0.0	0.0	0.0
11	MSS-RSS	1.00		0.0	0.0	0.0	0.0	0.0	0.0
12	RSS-ESLO	7.88	ACROMIAL BRDTH	0.0	0.0	0.0	0.0	0.0	0.0
13	ESLOR	0.0		2.205	0.0	2.163	0.0	1.948	-0.300
14	RUPARM	10.46	SHOULDR-ELB LGTH	1.623	0.509	1.623	0.0	1.623	-0.771
15	ELWARM	10.10	ELBOW-WRIST LGTH	1.049	0.0	1.049	0.0	1.049	0.0
16	RWRIPTR	1.92	HAND LENGTH	1.917	0.0	0.505	0.0	3.615	1.692
17	RFNGR	9.51	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
18	RFNGRTIP	7.23	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
19	MSS-LSS	1.00		0.0	0.0	0.0	0.0	0.0	0.0
20	LSS-LSLO	7.88	ACROMIAL BRDTH	0.0	0.0	0.0	0.0	0.0	0.0
21	LSLOR	0.0		2.205	0.0	2.163	0.0	1.948	-0.300
22	LUPARM	10.46	SHOULDR-ELB LGTH	1.623	0.509	1.623	0.0	1.623	-0.771
23	LLWARM	10.10	ELBOW-WRIST LGTH	1.049	0.0	1.049	0.0	1.049	0.0
24	LWRIPTR	1.92	HAND LENGTH	1.917	0.0	0.505	0.0	3.615	1.692
25	LFNGR	9.51	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
26	LFNGRTIP	7.23	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
27	HIP-CHP	3.21	HIP BREADTH	2.922	-0.317	2.922	0.0	3.697	-0.075
28	SRP-LEG	16.19	BUTTOCK-KNEE LGTH	1.990	0.0	1.990	-0.092	1.990	-0.092
29	RLWPLEG	15.34	KNEE HGT/SITTING	1.318	0.0	1.316	0.0	1.318	0.0
30	RWR-RKNE	2.14	KNEE HGT/SITTING	5.081	-3.161	1.870	0.0	1.242	0.0
31	HIP-LHP	3.21	HIP BREADTH	2.922	-0.317	2.922	0.0	3.697	-0.075
32	LSRPLEG	16.19	BUTTOCK-KNEE LGTH	1.990	0.0	1.990	0.092	1.990	-0.092
33	LLWPLEG	15.34	KNEE HGT/SITTING	1.318	0.0	1.316	0.0	1.318	0.0
34	LWR-LKNE	2.14	KNEE HGT/SITTING	5.081	-3.161	1.870	0.0	1.242	0.0

END OF JOB.

Figure 39a. Surface Dimension and Internal Link Lengths Calculated by CBM04.

CB40, --- COMBIMAN PROGRAM VER. 4. 2/29/80 9. 0. 2 PAGE 2

COMBIMAN ANTHROPOMETRIC DATA

REFERENCED SURVEY OF REGRESSION EQUATIONS IS R67 USAF
REFERENCED SURVEY OF ANTHROPOMETRIC DIMENSIONS IS 67 USAF

-USER SUPPLIED INDEPNDNT VALUES- VBL. NAME	VALUE	UNIT	-CNVRTD DFLT- VALUE	UNIT
SITTING HEIGHT	5	PCT	34.700	IN
WEIGHT	5	PCT	140.150	LB

-----COMPUTER CALC. DEP. VALUES-----

NO.	VBL. NAME	VALUE	UNIT
1	WEIGHT	140.150	LB
2	SITTING HEIGHT	34.700	IN
3	ACROMION HGT/SIT	22.449	IN
4	KNEE HGT/SITTING	20.840	IN
5	BUTTOCK-KNE LGTH	22.610	IN
6	SHOULDR-ELB LGTH	13.523	IN
7	BIACROMIAL BRDTH	15.375	IN
8	HIP BREADTH	12.941	IN
9	CHEST DEPTH	8.939	IN
10	FOOT LENGTH	10.162	IN
11	HAND LENGTH	7.229	IN
12	ELBOW-WRIST LGTH	11.284	IN

Figure 39b. Printed Output of the Two Selected Independent Variable Values Calculated by CBM04.

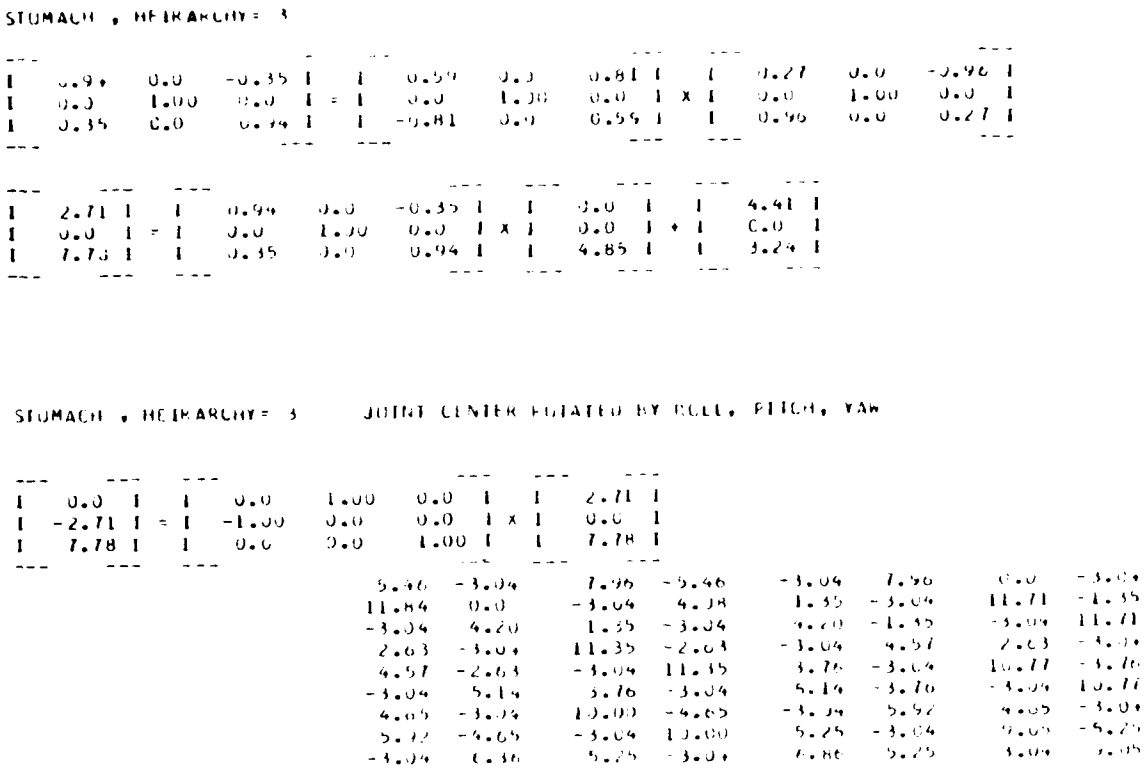


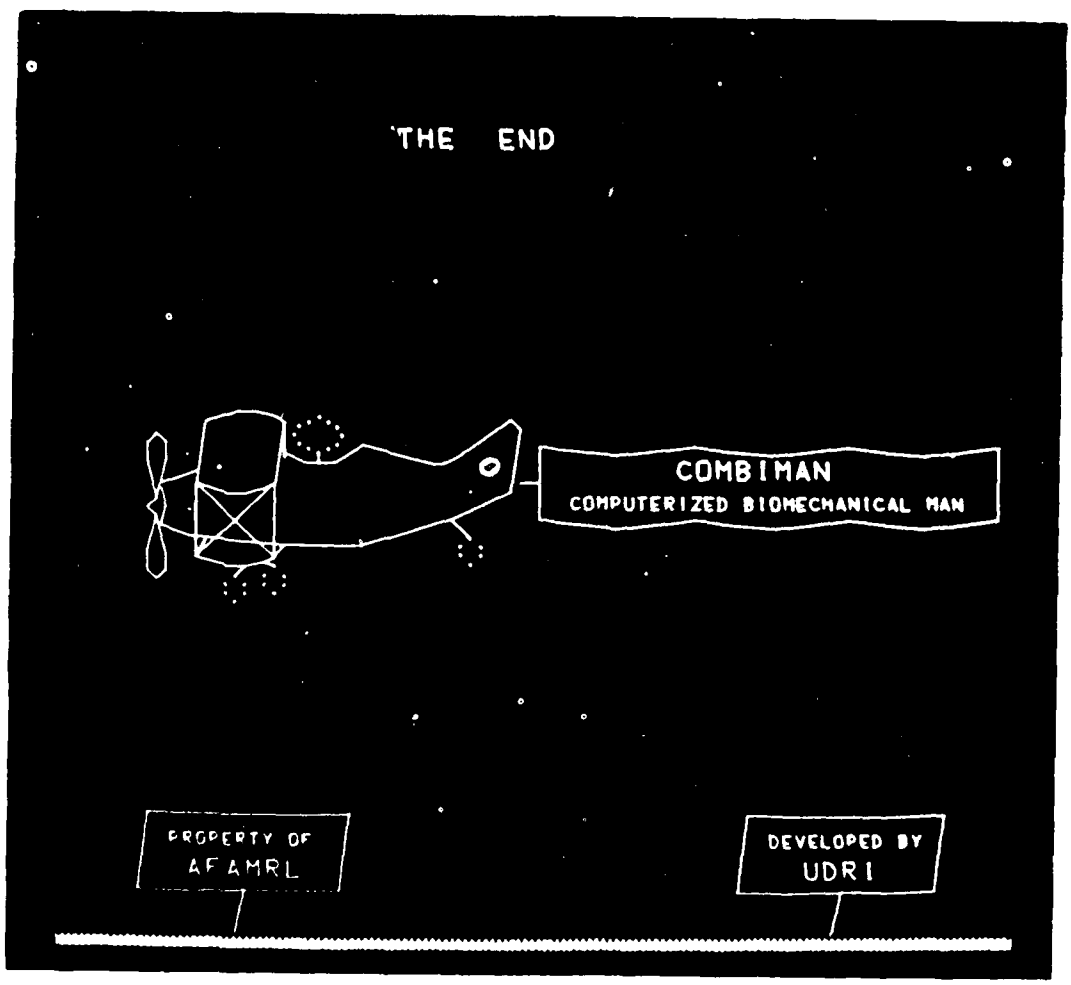
Figure 40. Transformation Equation Developed for Positioning Stomach Link (Set State Switch 72 ON).

2.2.24 RESTART PROGRAM Function (PFK30)

The RESTART PROGRAM function allows the user to start program CBM04 over again as though the program is executed from the start. When this function is evoked, all temporary files are erased and all State Switches and Anthropometric dimensions must be redefined.

2.2.25 END PROGRAM Function (PFK31)

The END PROGRAM function displays the COMBIMAN Banner and terminates the program CBM04.



END OF COMBIMAN PROGRAM.

2.3 EXECUTING THE JOB

This sequence is intended to assist the user in loading the program CBM04, specifying processing, handling error procedures, obtaining output, and ending the program. It will not describe data formats and program functions as these are described in detail in Paragraph 2.2 of this section.

2.3.1 Loading the Program CBM04

The Job Control Cards to load the program CBM04 are shown in Figure 41. The program begins execution by displaying the COMBIMAN banner. Depressing PFK0 lights up enabled PFKs and displays the message "DEPRESS PFK4". Now the user can begin processing the man-model by depressing PFK4 to select anthropometry. Explanation of the processing performed by enabled or lighted function keys are explained in Paragraph 2.2.

All input data are kept on data bases created and maintained by the programs CBMAM, CBMCM, and CBMVM (see Sections 4, 5, and 6). The user may select data from these data bases or may modify them to suit the situation. All interactions with the program are done through the Program Function Keyboard (PFK), the Alphanumeric Keyboard (ANKB), and the Light Pen (LP).

```
//COMBIMAN JOB MESS                                                     00001000
//JOBLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR                             00001100
//STEP1    EXEC PGM=CBM04,REGION=550K                                   00001200
//*********************************************************************00001300
//*                                                                   * 00001400
//*         THE INITIALIZATION,  ANTHROPOMETRIC, CREW STATION,        * 00001500
//*         AND VISIBILITY MEMBER DATA SETS ARE ASSUMED TO BE         * 00001600
//*         ON DISK AND CATALOGED.                                    * 00001700
//*         THEIR JCL PARAMETERS ARE SUPPLIED ON COMMENT CARDS        * 00001800
//*                                                                   * 00001900
//*********************************************************************00002000
//SYSUT1   DD SPACE=(TRK,(40)),UNIT=SYSDA                             00002100
//*                WORKSPACE FOR GOULD PLOTTER                        * 00002200
//SYSPLOT  DD SYSOUT=A                                                00002300
//*                MESSAGE UNIT FOR GOULD PLOTTER                     * 00002400
//SYSPLOT  DD UNIT=GOULD                                              00002500
//*                ONLINE GOULD 4800 PLOTTER                          * 00002600
//FT01F001 DD DSN=COMBIMAN.INITDATA,DISP=SHR                          00002700
//*           DCB=(RECFM=VBS,LRECL=164,BLKSIZE=3280)                  * 00002800
//*           SPACE=(3280,(8,1),RLSE)                                 * 00002900
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,DISP=SHR                          00003000
//*           DCB=(RECFM=F,LRECL=248,BLKSIZE=248)                     * 00003100
//FT03F001 DD DSN=COMBIMAN.CRSTDATA,DISP=SHR                          00003200
//*           DCB=(RECFM=F,LRECL=368,BLKSIZE=368)                     * 00003300
//FT05F001 DD DSN=COMBIMAN.SMPLANTH,DISP=SHR                          00003400
//*                CARD IMAGE                                         * 00003500
//FT06F001 DD SYSOUT=A                                                00003600
//FT07F001 DD SYSOUT=B                                                00003700
//FT08F001 DD DISP=(,PASS),SPACE=(1210,(50,20)),UNIT=SYSDA,           00003800
//            DCB=(LRECL=121,RECFM=FB,BLKSIZE=1210)                   00003900
//*                TEMPORARY DATA SET                                 * 00004000
//FT09F001 DD DSN=COMBIMAN.VISDATA,DISP=SHR                           00004100
//*           DCB=(RECFM=F,LRECL=240,BLKSIZE=240)                     * 00004200
//FT10F001 DD UNIT=2250-3                                             00004300
//*                IBM DISPLAY UNIT 2250-3                            * 00004400
//FT11F001 DD DSN=COMBIMAN.PLOTDATA,DISP=SHR                          00004500
//*           DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)                     * 00004600
//*                OFF-LINE PLOT DATA SET                             * 00004700
//SYSABEND DD SYSOUT=A                                                00004800
//STEP2    EXEC PGM=IEBGENER,COND=EVEN                                00004900
//*                PRINTS MESSAGES                                    * 00005000
//SYSPRINT DD DUMMY                                                   00005100
//SYSIN    DD DUMMY                                                   00005200
//SYSUT1   DD DSN=*.STEP1.FT08F001,DISP=(OLD,DELETE)                  00005300
//SYSUT2   DD SYSOUT=A,DCB=(BLKSIZE=121,RECFM=FA)                     00005400
//                                                                    00005500
```

Figure 41. JOB CONTROL CARDS to Execute CBM04.

2.3.2 Error Procedures

The program CBM04 performs some preliminary error checking on the user supplied data. The majority of checking is for data values which are outside the limits built into the program or the wrong type (i.e. alpha or numeric). For example, State Switch numbers must be between 1 and 72, the maximum number of panels for any crew station configuration to be displayed cannot exceed 250, and all man-model dimensions entered must be positive values. When the user light-pens or types in values which are out of range, the program prompts the user to retry the entry. Numerical values can be typed with or without a decimal point, at the user's option.

Example 1. Enter State Switch number "3".

This can be done in any one of the following ways.

(a) Type "3" and depress ALT-CODE/5.
(b) Type "3." and depress ALT-CODE/5.
(c) Type "3.0" and depress ALT-CODE/5.

If the program expects a whole number, decimal values are rounded off to the nearest Integer. Example 3.4 and 2.7 are rounded off to 3.

If the program expects two decimal places, the input number is rounded off accordingly.

Example 2. Change a value in the link table from 10.50 to 11.32.

Light-pen 10.50, then Type "11.32" and depress ALT-CODE/5.
Typing "11.319" or 11.3215" and depressing ALT-CODE/5 has the same effect as entering 11.32.

If a Program Function Key is depressed the corresponding function as described in Paragrahh 2.2 is enabled. However, if a key is pressed erroneously, the following procedure may be followed.

For Program Function Keys 0, 1, 2, 3, 6, 7, 8, 11, 14, 16, 18, and 29 depress ALT-CODE/5 to cancel the selection of that function.

With Program Function Keys 4, 9, 12, 13, 23, 24, 25, 27, 30, and 31, the function must be executed.

For Program Function Key 5, light-pen "(NONE)" in the display to cancel execution of the RETRIEVE CREW STATION function.

For Program Function Key 22, depress the temporarily defined PFK2 to return to the graphics routine.

For Program Function Key 26, depress PFK0 and light-pen the appropriate "VIEW".

2.3.3 Ending the Program

There are three ways to end program CBM04. The primary method for terminating the program is through CBM04, using the END PROGRAM function key (PFK31). Another method to terminate execution of the program is to use the CANCEL key on the IBM 2250 Alphanumeric Keyboard. When CANCEL key and ALT CODE key are depressed together, the three options shown in Figure 42 are displayed.

Light-penning the "TERMINATE" option terminates the program without producing a memory dump of program CBM04. The "DUMP" option terminates the program and produces a full storage dump. The "RESUME" resumes the execution of program CBM04 as though the CANCEL key had not been used.

The third option is to cancel the program from the computer operator's console.

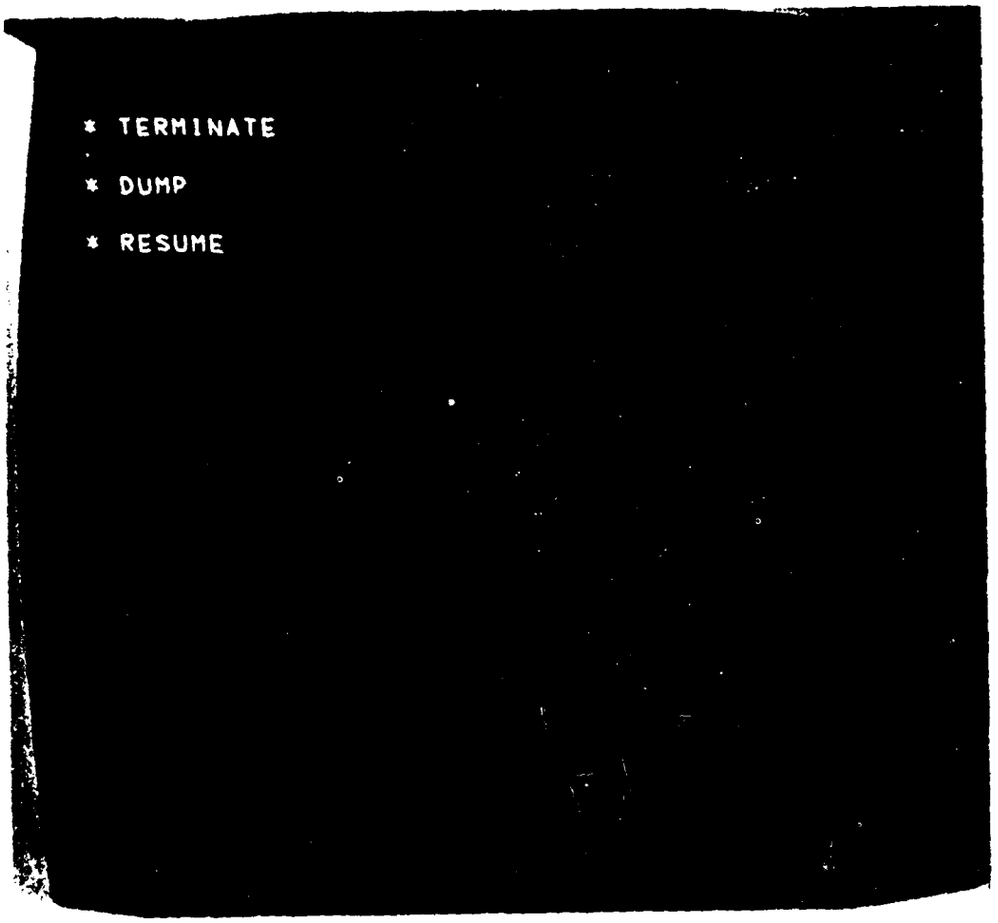


Figure 42. Options Displayed on Depressing A, D, or R and CANCEL Keys Together.

2.4 PROGRAM MESSAGES-INFORMATION AND ERROR TYPE

The program CBM04 prints out both information and action oriented messages. The message format is as follows:

CBM0nni Message Text

where:

CBM	- identifies the message as coming from the COMBIMAN system,
0	- identifies the message as coming from program CBM04,
nn	- is the message number,
i	- is the action code (I=information, A=action to be performed), and
Message Text	- is the message text.

The messages are as follows:

CBM001I COMBIMAN V4, DATE=MM/DD/YY, TIME=hh.mm.ss.
Issued By: CBMINT.
Reason: Program CBM04 started at this date and time.
System Action: Execution continues.
User Action: None.

CBM002I PROGRAM END.
Issued By: CBMRTS.
Reason: The user either requested the "END PROGRAM" function or the "RESTART PROGRAM" function.
System Action: The program either ended or restarted as requested.
User Action: None.

CBM007I panel numbers.) panel name, TYPE=nn, nn VERTICES.
Issued By: CBMCSR.
Reason: The user defined a panel to the system through the "DESIGN PANEL" function.
System Action: The defined panel is accepted.
User Action: None.

CBM009I SWITCH switchnumber ON/OFF
Issued By: CBMSSW.
Reason: The user requested a program switch change using the SWITCH STATE function.
System Action: Switch switchnumber is now either "ON" or "OFF."
User Action: None.

CBM010I IDENTIFIED objectname
Issued By: CBMIOI.
Reason: The user requested the "IDENTIFY OBJECT" function to identify an object displayed on the screen.
System Action: The system displays on the screen the object's name, distal-end coordinates and internal "key" number.
User Action: None.

CBM011I OMITTED objectname
Issued By: CBMIOI.
Reason: The user requested that an object be removed from the display using the "OMIT OBJECT" function.
System Action: The light penned object is removed from the screen, and that object's name, distal-end point coordinates and internal "key" number are displayed on the screen.
User Action: Record the internal "key" number in order to include the object in the display at a later time.

CBM012I INCLUDED objectname
Issued By: CBMIOI.
Reason: The user requested that an object be included back into the display via the INCLUDE OBJECT function.
System Action: The requested object was included back into the display.
User Action: The user specified the internal "key" number of the object to be included.

CBM014I Crew Station DATA FROM membername
Issued By: CBMCSR.
Reason: The user requested the retrieval of a crew station definition by the RETRIEVE CREW STATION function.
System Action: The requested crew station member is retrieved.
User Action: None.

CBM015I SURVEY DATA FROM membername
Issued By: CBMIN1.
Reason: The user requested membername Survey Data from the Anthropometric Data Base.
System Action: The requested survey data are retrieved.
User Action: None.

CBM016I VIEW=(roll, pitch, yaw), SCALE=factor, OFFSET=(x,y,z).
Issued By: CBMDSP.
Reason: The user requested a new off-axis view through the "CHANGE VIEW" function.
System Action: The display is rotated as specified.
User Action: None.

CBM018I INITIALIZATION DATA MISSING.
Issued By: CBMINT.
Reason: Initialization Data could not be found.
System Action: The program is terminated.
User Action: Check to see that the initialization data has not been destroyed.

CBM019I PLOTS COMPLETED.
Issued By: CBMCP1.
Reason: The requested hard copy plot of the COMBIMAN display is finished.
System Action: None.
User Action: None.

CBM022A TOO MANY PANELS/VERTICES.
Issued By: CBMCSR.
Reason: More panels were defined through the RETRIEVE CREW STATION function (PFK05) or the "DESIGN PANEL" function (PFK16) than could be handled at one time. The maximum number of panels that can be handled at one time is 250.
System Action: The panel being defined is ignored.
User Action: Delete a few panels by the DELETE PANEL function (PFK18) or delete a crew station using the RETRIEVE CREW STATION function before defining more panels.

CBM023A ANTHROPOMETRIC SURVEY MEMBER membername, TYPE t, NOT FOUND.
Issued By: CBMIN1.
Reason: The user requested the survey data member membername to be retrieved, but that member could not be found on the Anthropometric Data Base.
System Action: Another survey data member name is requested.
User Action: Check that the survey data member membername has not been destroyed.

CBM026I DELETE PANEL panelname.
Issued By: CBMCSR.
Reason: The user requested to delete panel panelname using the DELETE PANEL function.
System Action: The panel is deleted.
User Action: None.

CBM031A Crew Station DATA BASE MISSING
Issued By: CBMCSR.
Reason: Identification record of the file containing crew station data is missing.
System Action: Displays similar message to CRT and returns control to main program.
User Action: Stop program, if crew stations are needed.

CBM033I REGRESSION VALUES FROM MEMBER membername.
Issued By: CBMIN1.
Reason: User entered a valid regression or type 0 anthropometric data base membername using light pen.
System Action: Data from the referenced member are read into arrays.
User Action: None.

CBM034A ANTHROPOMETRIC DATA BASE MISSING.
Issued By: CBMINT, CBMIN1.
Reason: The identification record of the file which is supposed to contain anthropometric data is missing.
System Action: Displays similar message to CRT operator and returns control to main program.
User Action: Stop program; create anthropometric data base.

CBM035A VARIABLE NO. nn OF REGRESSION SURVEY membername HAS INVALID UNIT OF uu.
Issued By: CBMIN1.
Reason: The unit of measurement read in for the specified variable and survey was not either IN, CM, MM, LB, or KG.
System Action: Remainder of data for variable is read in.
User Action: Report condition to systems programmer.

CBM039I UNIT OF VARIABLE vblname HAS BEEN CHANGED TO uu.
Issued By: CBMIND, CBMDEP.
Reason: The user changed the default unit of measurement of the specified variable.
System Action: Flag the unit as being changed.
User Action: None.

CBM040A INVALID UNIT OF uu SPECIFIED FOR VARIABLE vblname.
Issued By: CBMIND, CBMDEP.
Reason: The variable in question was defined in the anthropometric survey as having a length or weight type of measurement. The unit specified by the user was not consistent with the original definition.
System Action: Change ignored.
User Action: Respecify unit or keep default unit.

CBM041I INPUT VARIABLES WILL BE IN PERCENTILES.
Issued By: CBMIND, CBMDEP.
Reason: User has indicated that values for the anthropometric variables will be given as percentiles.
System Action: None.
User Action: None.

CBM042I INPUT VARIBLES WILL BE IN ABSOLUTE VALUES.
Issued By: CBMIND, CBMDEP.
Reason: User has indicated that values for anthropometric variables will be given as actual dimensions.
System Action: None.
User Action: None.

CBM043I USER CHOOSES TO INPUT nn DEPENDENT VARIABLES.
Issued By: CBMDEP.
Reason: User has depressed PFK12, indicating decision to enter values for all the dependent variables.
System Action: None.
User Action: None.

CBM044I STANDARD ERROR MULTIPLICATION FACTOR RESET TO nnn.nn.
Issued By: CBMIND.
Reason: User has entered a new value for standard error of estimate.
System Action: Value changed internally.
User Action: None.

CBM045I USER CHOOSES TO INPUT 2 INDEPENDENT VARIABLES.
Issued By: CBMIND.
Reason: User has depressed PFK13, indicating decision to enter values for two independent variables.
System Action: None.
User Action: None.

CBM046A ANTHROPOMETRIC DIMENSION vblname REFERENCED BY LINK link name DOES NOT EXIST IN MEMBER membername.
Issued By: CBMIN1.
Reason: One of the vital anthropometric dimensions needed to generate the link length in question does not exist in the referenced survey member.
System Action: Program ends.
User Action: Print contents of referenced member (from Anthropometric Data Base).

CBM047A ABNORMAL PROGRAM END.
Issued By: CBMIN1.
Reason: Key data vital to the construction of the man-model was not available.
System Action: Program ends.
User Action: Contact systems programmer.

CBM048I DATA WRITTEN FOR OFF-LINE PLOT NO. nn.
Issued By: CBMCP1.
Reason: Coordinate and index data for man-model and crew station configuration have been written onto disk file specified by FT11-DD card. Plot set is nn^{th} written during present computer run.
System Action: None.
User Action: None.

CBM049A I/O ERROR ON UNIT 11. OFF-LINE PLOT DATA FOR PLOT nn NOT SAVED.
Issued By: CBMCP1.
Reason: Input-output error occurred on file where coordinate data were to be written. Plot data for plot nn were not saved on file.
System Action: Return to calling program.
User Action: Contact systems programmer.

CBM051I VISIBILITY PLOT GENERATED SUCCESSFULLY.
Issued By: CBMVIS.
Reason: Successful completion of visibility plot.
System Action: None.
User Action: None.

CBM052A END OF DATA ON UNIT 9.
Issued By: CBMVIS.
Reason: Insufficient data on Unit 9 to generate visibility plot.
System Action: Return to calling program.
User Action: Contact systems programmer.

CBM053A NUMBER OF COMBINATIONS OF INDEPENDENT VARIABLES SUPPLIED BY MEMBER survey name DOES NOT EQUAL THAT SUPPLIED BY MEMBER regression name.
Issued By: CBMIN1.
Reason: Values for number of independent combinations do not correspond.
System Action: Values supplied by regression member are used.
User Action: Contact systems programmer.

CBM054A NUMBER OF DEPENDENT VARIABLES SUPPLIED BY MEMBER survey name DOES NOT EQUAL THAT SUPPLIED BY MEMBER regression name.
Issued By: CBMIN1.
Reason: Values for number of dependent variables do not correspond.
System Action: Values supplied by regression member are used.
User Action: Contact systems programmer.

SECTION 3
OFF-LINE PLOT PROGRAM (CBMOFF)

When the user needs a plot which cannot be done On-Line,[1] the OFF-LINE PLOT COMBIMAN function (PFK7) is depressed to store the man-model and crew station coordinate data of the display currently on the CRT (see Paragraph 2.2.8). The user may store as many sets of these data as desired on data set unit 11 (see FT11F001 DD card on Figure 41). Program CBMOFF plots these data using Calcomp compatible software. The user specifies the data sets to be plotted, as well as plot size, color, and content.

The following information in intended as a programmer's guide to use the program CBMOFF.

3.1 PROCESSING AVAILABLE

The following two input cards must be supplied along with the plot data file.

(1) the NAMELIST/CNTRL/, and
(2) a card with the plot numbers of those data sets not to be plotted.

The information supplied on these cards allows the user to vary plot size, plot color, and plot content as follows:

(1) The NAMELIST/CNTRL/'s variables and their default values:
FACTR - When specified, FACTR is the plot scale factor for that program run, otherwise, the scale factors specified for each plot during the COMBIMAN run when the data were generated (see Paragraph 2.2.8) will be used.

[1] At WPAFB we use an AFAMRL, 11" Model 4800 Gould electrostatic plotter for On-Line plots and a 3-color, 30" Calcomp plotter with a resolution of 0.002" for report quality output and quarter-scale Off-Line plots.

LINKS, FLESH, and CRST - These three variables allow the user to eliminate the LINK System, the enFLESHment, and/or the CRew STation respectively from plots for that program run. Specifying LINKS, FLESH, and/or CRST equal to "1" deletes that element(s) from the plots. Default values

LINKS=0
FLESH=0, and
CRST=0

cause all elements of the CRT display to be plotted.

(ICOLOR(I), I=1,4) - ICOLOR(I) determines the pen color for element "I" of the plot where,

I=1 is the plot banner,
I=2 is the link system,
I=3 is the enfleshment, and
I=4 is the crew station.

Default[2] values are ICOLOR(1)=1
ICOLOR(2)=1
ICOLOR(3)=2
ICOLOR(4)=3

The format of the Namelist CNTRL is as follows (see Figure 43a):

column 1 - a blank
column 2 - a $[3]
columns 3-7 - the word CNTRL
column 8 - a blank

[2]When an off-line plot is made, the requester specifies the color assignments.

[3]This symbol is for use of the program on a CDC computer: other computers may have different symbols for this purpose.

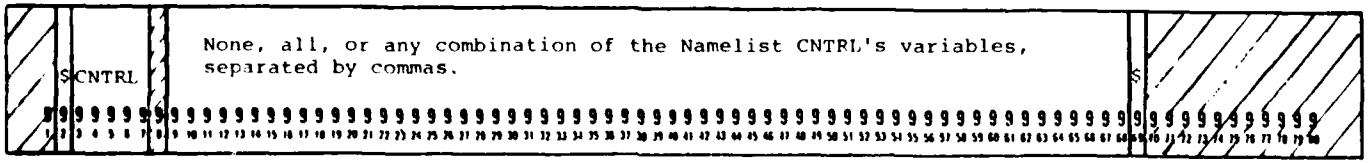


Figure 43a. The Format of the Namelist CNTRL.

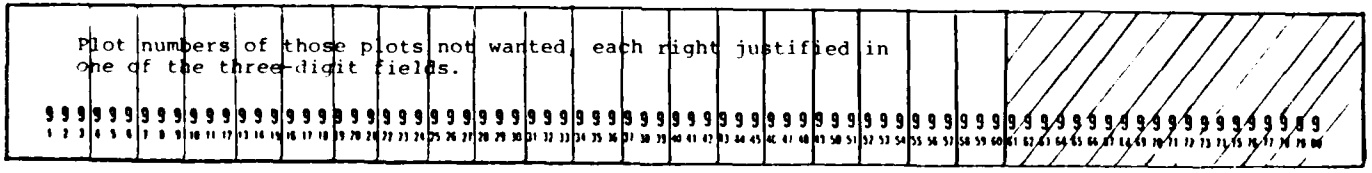


Figure 43b. The Format of the Data Card for Unwanted Plots.

After column 8 comes none, all, or any combination of the control variables in the form FLESH=1, FACTR= .95, ICOLOR(2)=3, ..., the last one followed by a "$" indicating end of the NAMELIST variable input.

(2) The format for the data card containing the plot numbers of those plots not to be plotted is shown in Figure 43b. The data card can contain up to twenty plot numbers, each right-justified integer in one of the 3-character fields in the first sixty columns of the card. The plot numbers can be in any order and do not need to fill consecutive fields. If the card is left blank, no plot will be skipped.

Figure 43c shows an Off-Line plot of the man-model (with full skeletal link system) and a crew station, just as it would appear on the CRT. The plot banner shown in Figure 43d indicates that the plot is a perspective plot with scale factor 0.85. The data card input for this plot is shown in Figure 43e. Notice that all values except ICOLOR(3) and ICOLOR(4) remain at their default values in the NAMELIST/CNTRL/. This implies that the scale factor for the plot is the one specified during the COMBIMAN run when the plot data were generated. The link system, enfleshment, and crew station as displayed on the CRT, are included in the plot. Also with ICOLOR(3) and ICOLOR(4) each set equal to 1 in the input, all elements of the plot will be the same color (in this case black). Also notice that the second input card contains a 1 in column six denoting that plot number 1 is to be skipped (this being plot number 2).

Figure 43f shows the input cards used to generate Figure 43c from the same plot data. FACTR= 0.55 resets the plot scale factor to 0.55, FLESH=1 deletes all enfleshment from the man-model, and the color of all plot elements is again black.

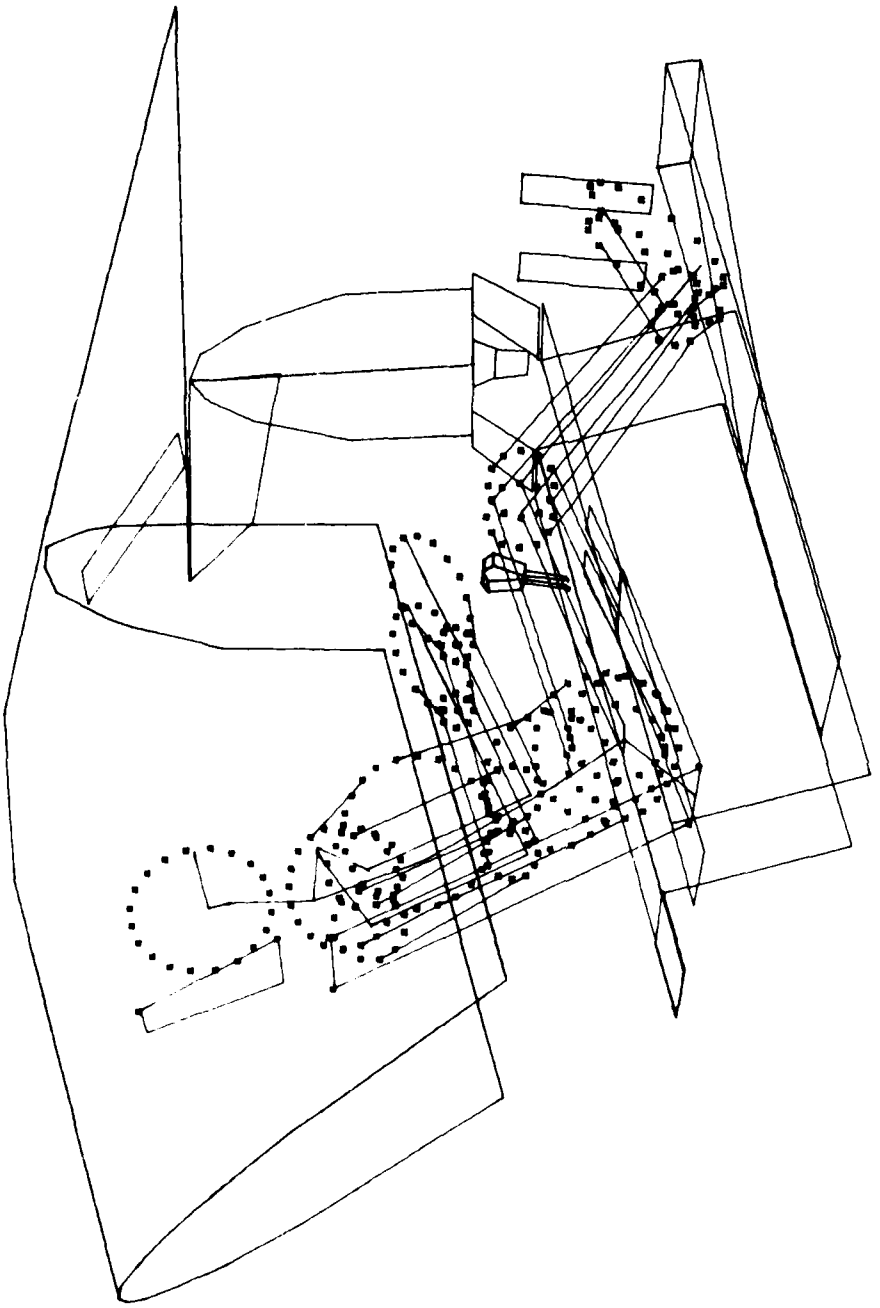


Figure 43c. COMBIMAN OFF-LINE Plot.

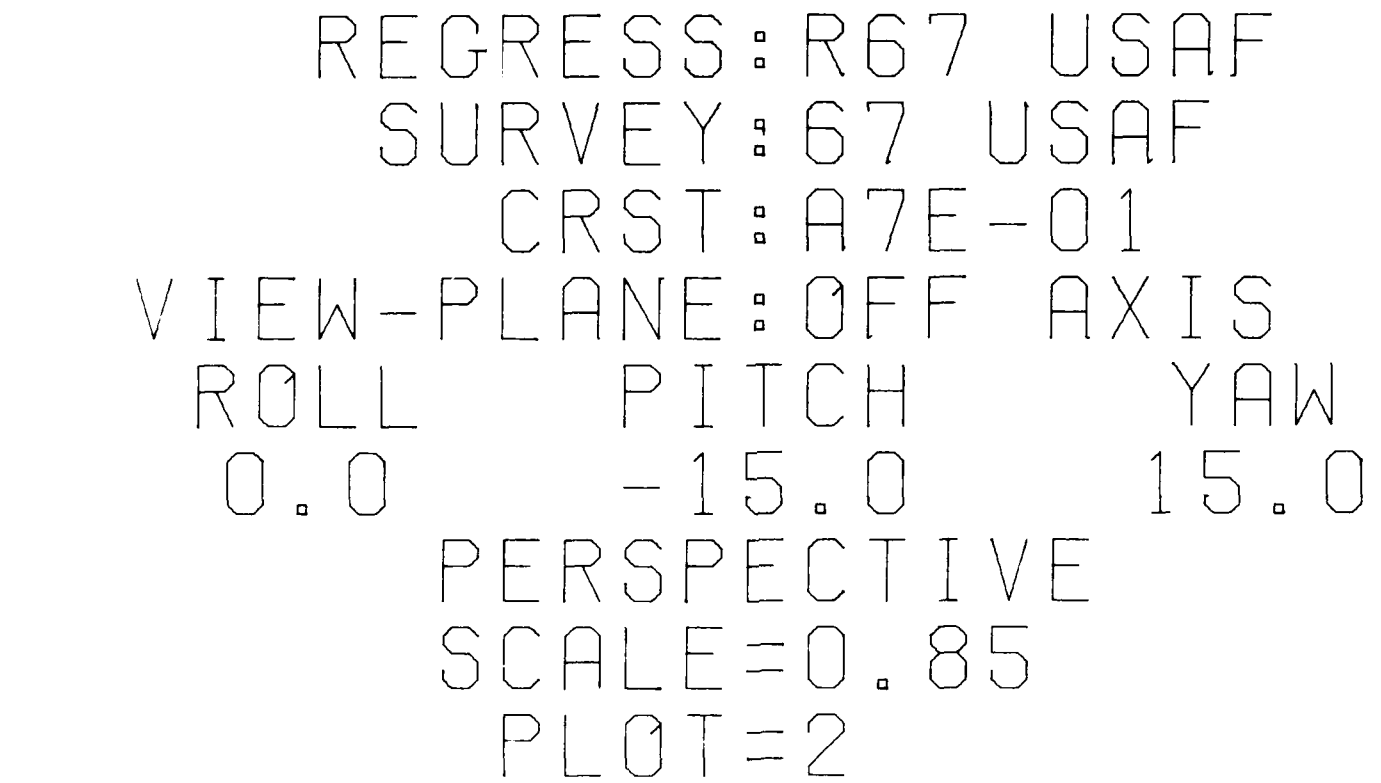


Figure 43d. Plot Banner for the Plot Shown in Figure 43c.

```
$CNTRL ICOLOR(3)=1, ICOLOR(4)=1$
```

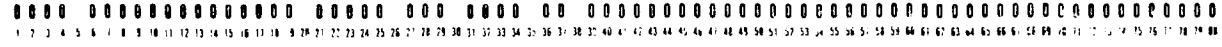
Card 1

Card 2

Figure 43e. Card Input for Figure 43c.


```
$CNTRL ICOLOR(3)=1, IFLESH=1, FACTR=0.55$
```

Card 1



Card 2

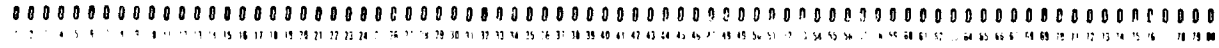


Figure 43f. Card Input for Figure 43g.

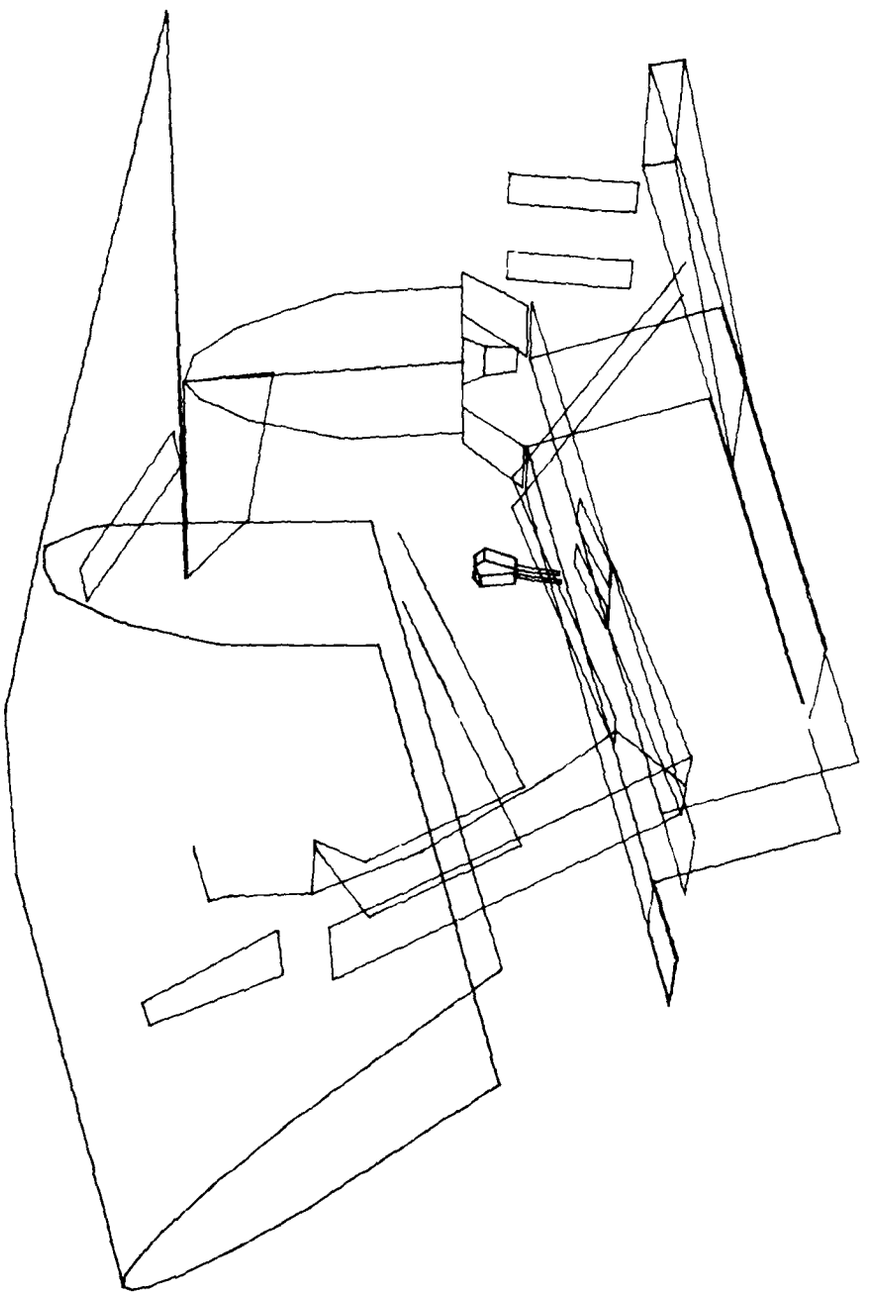


Figure 43g. Altered COMBIMAN OFF-LINE Plot.

3.2 PROGRAM MESSAGES INCLUDING ERROR CORRECTION

The program CBMOFF prints both information and action related messages. The message format for both is as follows:

CBM2nni message text

where:

nn is the message number,

i indicates the action code (I=Informational, A=Action to be performed), and

message text is the text of the message.

CBM201I PLOT SET plotnumber WAS NOT PLOTTED -- BY REQUEST.
Reason: User requested that plot plotnumber not be plotted.
System Action: Plot plotnumber is not plotted.
User Action: None.

CBM202A INCORRECT AMOUNT OF DATA FOR PLOT plotnumber -- PROGRAM ENDING.
Reason: There were too much or too little data on the file for plot plotnumber.
System Action: No plotting occurs, and program ends.
User Action: Recreate plot file.

CMB203I SCALE FACTOR CHANGED FROM factor1 TO factor2.
Reason: User input a value for FACTR (factor2) in the namelist CNTRL.
System Action: factor2 is used to scale the plot.
User Action: None.

SECTION 4

COMBIMAN ANTHROPOMETRIC DATA BASE MAINTENANCE PROGRAM (CBMAM)

As the COMBIMAN has become more sophisticated, the user is often asked to supply more anthropometric data to generate the man-model. To simplify this task for the user a Data Base is constructed to store key data items. This Data Base resides on a direct-access disk, and contains anthropometric survey and regression data relevant to generating the man-model.

Information on the Data Base is organized into groups of related records called members. Members may be either regression data, or anthropometric survey data. Data for survey members are generally subsets of existing anthropometric surveys in the AFAMRL Anthropometric Data Bank. To add a new anthropometric survey to the Data Base, the key information needed includes the mean and standard deviation for each anthropometric variable and a set of correlation coefficients for all the relevant variables of the survey.

4.1 PROCESSING PERFORMED

The program CBMAM (COMBIMAN Anthropometric Data Base Maintenance Program) allows the user to create and maintain the Anthropometric Data Base. The user may supply the input data on 80 character computer card or in card image format on magnetic tape. The program CBMAM reads and processes the data according to the user's selection of control commands. These commands allow the user to add members to the Data Base, delete members from the Data Base, print or punch existing members, list the directory of the Data Base, or compress the data on the file to combined unused space. The data flow of the program is shown in Figure 44.

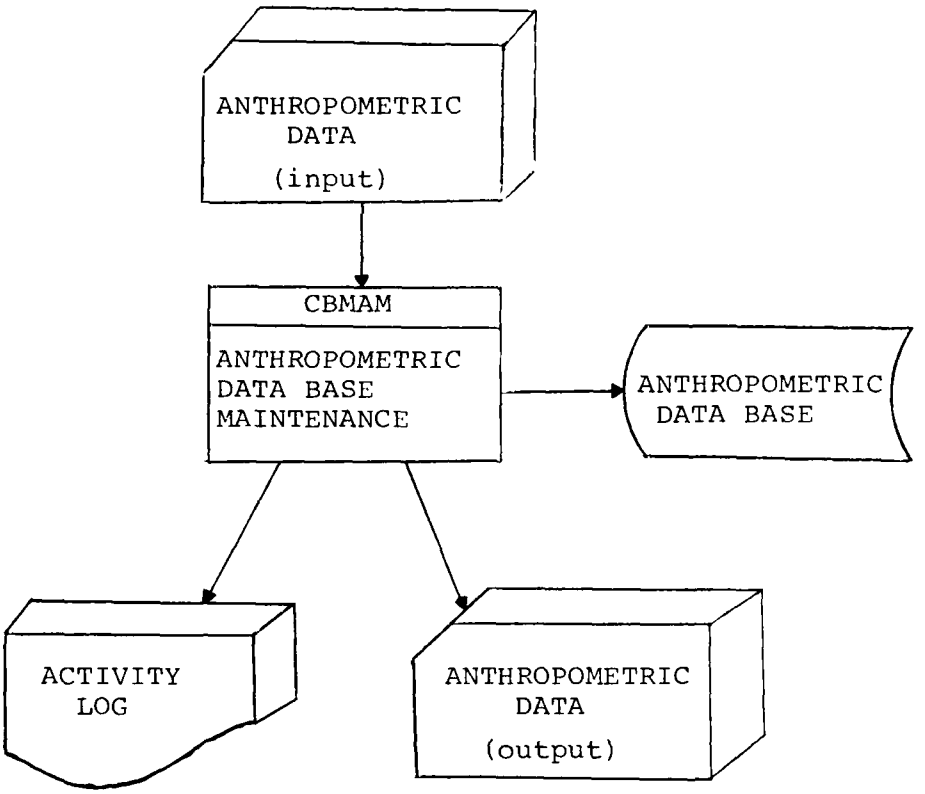


Figure 44. Data Flow for Program CBMAM.

The Data Base is made up of two types of related data. One type consists of regression data which is used by the interactive graphics program CBM04 when predicting anthropometric surface dimensions needed to generate the link system of the man-model. The second type consists of survey data which define the means, standard deviations, and percentiles for each variable for a particular survey. Each group of data, whether dealing with regression or survey information, is called an anthropometric member, and is referenced by the member's name and type classification.

4.2 RESTRICTIONS AND LIMITATIONS

The Anthropometric Data Base may contain a maximum of 20 members consisting of regression and survey types. The number of records for each member need not be the same but the sum of the record counts for all the members cannot exceed 1979. Information on the number of members on the Data Base and their size may be obtained by using the "+PRT" control card. This is explained in greater detail in Paragraph 4.3.2.9.

Additional limitations on the number of variables and related data are explained in Paragraph 4.3.2. Members to be added should have unique member names. If the new member name matches any name in the directory, the member will not be added.

4.3 HOW TO USE PROGRAM CBMAM

The surveys used in COMBIMAN are subsets of the 1967 Survey of the USAF Flying Personnel (Churchill, et al, 1976) and the 1970 Survey of U.S. Army Aviators (Churchill, et al, 1971). As new surveys become available, or subsets of existing surveys in he AFAMRL Data Bank become needed, the program CBMAM is used to add these new members. In most cases, each new survey type member has a corresponding regression type member which contains multiple and single regression equation coefficients to predict additional anthropometric variables from those which the user

specifies. In a few cases, one regression type member may be referenced by several survey type members. These are special cases, however, and this practice should not be used regularly without first consulting with personnel in the Workload and Ergonomics Branch of the Air Force Aerospace Medical Research Lab. Wright-Patterson Air Force Base, Ohio to verify the statistical accuracy of the regression data of the anthropometric survey in question.

All examples illustrating the use of CBMAM will be based on the 1967 USAF Flying Personnel survey and its regression type counterpart.

4.3.1 Identifying Input Data

The nucleus of the anthropometric variables considered for input as part of any anthropometric member should be the 12 variables required to generate the 35 internal link lengths of the man-model skeletal system. These variables and their 16 character abbreviations, where applicable, are listed in Table 5. Few users of COMBIMAN will have specific values in mind to input for each of the 12 variables. To accommodate this, additional anthropometric variables can be selected which are found to be good predictors of either body segment mass or body segment length, and have moderately high correlations with the 12 required variables. The variables chosen to predict mass and length for the 1967 Survey are shown in the appropriate columns of Table 6. Those variables in Table 6 which are both predictors and required dimensions are marked with an asterisk.

Alternately, the user may select one mass related and one length related variables from Table 6 and supply the values. The values for the 12 variables in Table 5 are computed using the regression equations from the Anthropometric Data Base.

Once the complete set of variables is established, it is necessary to obtain means, standard deviations, percentiles, and correlation coefficients for each variable of

TABLE 5

LIST OF DEPENDENT VARIABLES NEEDED TO GENERATE COMBIMAN LINK SYSTEM

	Name	16 Character Abbreviation (If Applicable)
1.	Weight	
2.	Sitting Height	
3.	Acromion Height, Sitting	(ACROMION HGT/SIT)
4.	Knee Height, Sitting	(KNEE HGT/SITTING)
5.	Buttock-Knee Length	(BUTTOCK-KNE LGTH)
6.	Shoulder-Elbow Length	(SHOULDR-ELB LGTH)
7.	Biacromial Breadth	(BIACROMIAL BRDTH)
8.	Hip Breadth	
9.	Chest Depth	
10.	Foot Length	
11.	Hand Length	
12.	Elbow-Wrist Length	(ELBOW-WRIST LGTH)

TABLE 6

LIST OF DEPENDENT VARIABLE PREDICTORS

	Mass Related		Length Related
1.	*Weight	1.	*Sitting Height
2.	Bideltoid Breadth	2.	Eye Height, Sitting
3.	Hip Breadth, Sitting	3.	*Knee Height, Sitting
4.	*Chest Depth	4.	*Buttock-Knee Length
		5.	Elbow-Grip Length
		6.	Thumb-Tip Reach

*Predictors and required dependent variables.

the particular survey from the AFAMRL Anthropometric Data Bank. The set of variables used for the 1967 Survey is shown in Table 7. A sample of the data obtained for Weight is shown in Figure 45.

The coefficients used in the regression equations are based on means, standard deviations and correlation coefficients for each variable, and on the equations which were developed in WADD-TR-60-31, pages 69-70 (Zeigen, et al, 1960). Tables 8 and 9 show the correlation coefficients matrices used in calculating the regression coefficients. The means, standard deviations, and correlation coefficients for 1967 USAF survey are available in AMRL-TR-77-2 (Churchill, et al, 1978).

The total number of multiple regression equations (NR) needed for a particular survey is calculated using the following equation:

$$NR = (NM \times NL) \times ND \qquad (1)$$

where NM is the number of variables related to body segment mass, NL is the number of variables related to body segment length, and ND is the number of dependent varibles. For 1967 Survey, each of the 24 combinations of mass-length-related dimensions has its own set of 12 multiple regression equations to compute the surface dimensions required to generate the man-model. In addition to multiple regression coefficients, simple regression coefficients and associated standard error of estimates are available for each of the 24 combinations. The standard units of measurement for all variables and coefficients used in COMBIMAN are pounds and inches, but there are provisions to change these metric units.

TABLE 7

LIST OF ANTHROPOMETRIC DIMENSIONS
AVAILABLE IN THE ANTHROPOMETRIC DATA BASE

1. Weight
2. Sitting Height
3. Eye Height, Sitting
4. Acromion Height, Sitting
5. Knee Height, Sitting
6. Buttock-Knee Length
7. Shoulder-Elbow Length
8. Elbow-Grip Length
9. Thumb-Tip Reach
10. Biacromial Breadth
11. Bideltoid Breadth
12. Hip Breadth
13. Hip Breadth, Sitting
14. Chest Depth
15. Foot Length
16. Hand Length
17. Elbow-Wrist Length

VARIABLE NAME: WEIGHT

MEAN: 173.60 LBS

STANDARD DEVIATION: 21.44 LBS

PERCENTILE DATA:

Percentile	1	2	3	5	10	15	20	25	30
Weight	127.58	132.63	135.82	140.15	146.89	151.53	155.27	158.56	161.56
Percentile	35	40	45	50	55	60	65	70	75
Weight	164.37	167.08	169.74	172.42	175.13	177.92	180.84	183.97	187.41
Percentile	80	85	90	95	97	98	99		
Weight	191.32	195.91	201.83	210.76	216.62	220.94	227.73		

Figure 45. Sample Data Obtained from Summary Statistics of 1967 Survey of the Air Force Rated Officers. (Churchill et al, September 1976)

TABLE 8

MATRIX OF CORRELATION COEFFICIENTS BETWEEN
MASS AND LENGTH RELATED VARIABLES (CHURCHILL, ET AL, SEPTEMBER 1976)

	Sitting Height	Eye Hgt, Sitting	Knee Hgt, Sitting	Butt-Knee Length	Elbow-Grip Length	Thumb-Tip Reach
Weight	.4568	.4119	.5386	.4544	.4085	.4138
Bideltoid Brdth.	.2782	.2598	.3398	.4379	.2514	.2784
Hip Brdth., Sitting	.3755	.3457	.4283	.5502	.3432	.3270
Chest Depth	.3333	.3078	.4084	.5479	.2882	.2965

TABLE 9

DEPENDENT AND INDEPENDENT VARIABLES (CHEBOTAR, ET AL, SEPTEMBER 1976)

	DEPENDENT VARIABLES									
INDEPENDENT VARIABLES										

4.3.2 Specifying the Processing Desired

The Anthropometric Data Base Maintenance program, CBMAM, allows the user to create and maintain the Anthropometric Data Base. The Data Base contains regression data which are used by the interactive graphics program CBM04 to predict anthropometric surface dimensions needed to generate the link system of the man-model. It also contains survey data which define the means, standard deviations, and percentiles for every defined variable for a particular anthropometric survey. Each group of data, whether dealing with regression or survey information, is called an anthropometric member, and is referenced by the member's name and type classification.

The program CBMAM allows the user to maintain the Data Base by the addition, deletion, listing, etc., of the member types through input cards as shown in Figure 46.

These control cards may be placed in any order in the input stream of the program, with one exception. If the Data Base is to be initialized for the first time, the +INT control card must be the first card. In each of the following subsections, the control card format of the function is listed first. This is followed by the text which explains each keyword. Additional data formats, if any, are then described for each function.

4.3.2.1 ADD ANTHROPOMETRIC MEMBER Function

+ADD membername type nvbl ncmb ndep npct regrname (followed by member definition)

The ADD ANTHROPOMETRIC MEMBER function, as defined by the +ADD control card and the member definition cards which follow, adds to the Anthropometric Data Base specific data under the name membername. The membername is an alphanumeric character string, no longer than 16 characters. The type field distinguishes between the two types of members. A type value of "0" signals that the member which follows contains regression information, while a type value of "1" signifies that the member contains survey dimensional data. The type value, as well as all

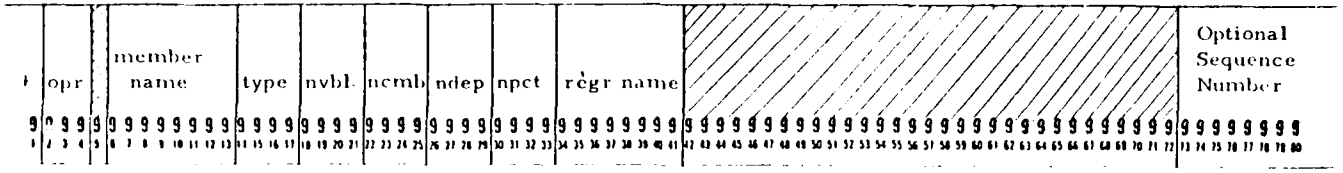


Figure 46. Program CBMAM Control Card Format.

other integer values supplied on the control card, must be right-justified within its field. The nvbl field defines the total number of variables described in member membername. The maximum number is 45. The ncmb field indicates the maximum number of combinations of independent mass and length variables. The maximum number is 50. The number of anthropometric variables needed to determine the internal link lengths is supplied in field ndep. The maximum number is 30. Fields, npct and regrname are used only when the type field value is 1. Npct contains the number of percentile values which will be supplied for every one of the nvbl variables. The maximum value for npct is 30. The regrname field references the type 0 membername which contains the appropriate regression information.

4.3.2.2 TYPE 0 MEMBERS

An example of an +ADD control card for a type 0 member in the 1967 Survey is outlined in Figure 47a. The membername is R67 USAF, and contains a total of 17 variables, with 24 combinations of independent variables, and 12 dependent variables. An example of an +ADD control card for a type 1 member is outlined in Figure 47b. The number of percentiles for each variable of member 67 USAF is 25, and the referenced regression type member is R67 USAF. Note that the values for nvbl, ncmb, and ndep are identical to the type 0 member R67 USAF, shown in Figure 47a.

Figure 48 shows the record formats used for type 0 members in the data base. The format in Figure 48a defines anthropometric variables used in this regression member. Columns 1-2 contain a sequence number for the variable, right-justified in the field. Columns 4-19 contain the 16-character name of the anthropometric variable. Columns 21-22 contain a two-character abbreviation for the default unit of measurement of the variable. Approved abbreviations are IN, CM, MM, LB, and KG pertaining to inches, centimeters, millimeters, pounds, and kilograms, respectively. A "1" punched in column 26, 30, or 34, indicates

```
+ADD R67 USAF    0  17  24  12
  1 WEIGHT                LB   1        1
  2 SITTING HEIGHT        IN        1   1
  3 EYE HGT/SITTING       IN        1
  4 ACROMION HGT/SIT      IN            1
  5 KNEE HGT/SITTING      IN        1   1
  6 BUTTOCK-KNE LGTH      IN        1   1
  7 SHOULDR-ELB LGTH      IN            1
  8 ELBOW-WRIP LGTH       IN        1
  9 THUMB-TIP REACH       IN        1
 10 BIACROMIAL BRDTH      IN            1
```

Figure 47a. Example of +ADD Control Card for Type 0 Member.


```
+ADD 67 USAF     1  17  24  12  25  R67 USAF
  1 2 3 5101520253035404550556065707580859095979899
  1 WEIGHT                LB 173.60686 21.434704127581326315821401514068915153
15527153561615616437167C81697417242175131779216066418397167411913219591
20183210762166222094227 73
  2 SITTING HEIGHT      IN 36.665932 1.2561024 3394 3424 3444 3470 3511 3539
  3562 3582 3606 3617 3633 3649 3665 3681 3698 3715 3733 3753 3775 3801
  3833 3880 3910 3931 3962
  3 EYE HGT/SITTING     IN 31.669176 1.1871142 2917 2950 2971 2998 3038 3065
  3087 3106 3123 3138 3153 3168 3185 3198 3215 3229 3240 3265 3280 3311
  3343 3390 3421 3443 3478
  4 ACROMION HGT/SIT    IN 24.03621  1.123410  2142 2177 2197 2224 2263 2289
  2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2495 2522
  2551 2594 2626 2639 2666
```

Figure 47b. Example of +ADD Control Card for Type 1 Member.

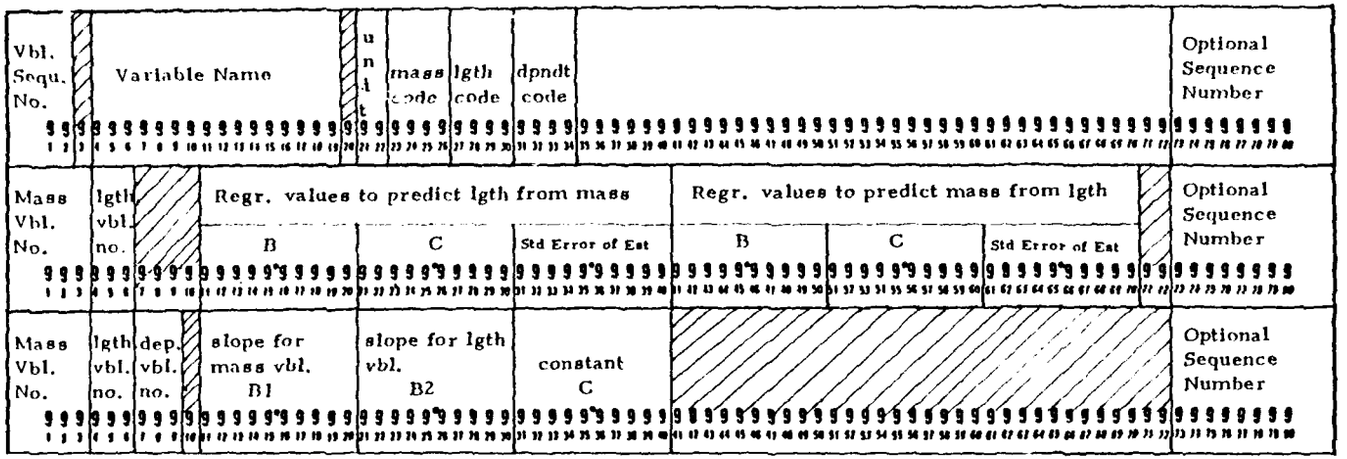


Figure 48.

(a) Program CBMAM Regression Member Variable Definition Card.

(b) Program CBMAM Regression Member Simple Regression Coefficient Definition Card.

(c) Program CBMAM Regression Member Multiple Regression Coefficient Definition Card.

a mass related independent variable, a length related independent variable or a dependent variable necessary to generate the link lengths respectively. A variable can either be independent or dependent, as in the case of sitting height, but cannot pertain to both mass and length. If all three fields are blank, the data card is flagged as containing an error. As each variable definition card is read in, the program checks the use of the variable and records its status.

The first outlined area of Figure 49 is an example of a Variable Definition Card. A "1" is punched in columns 30 and 34 to indicate that the Sitting Height is both an independent variable related to body segment length and a dependent variable.

Two types of record formats are used for each combination of mass and length related independent variables as shown in Figures 48b and 48c. In Figure 48b, the variable numbers, punched in columns 1-3 and 4-6 are obtained in columns 1-2 of the variable definition cards (Figure 48a). Columns 11-40 contain simple regression information necessary to predict the length related variable from the mass related variable. This information includes the slope and constant in the regression formula:

$$Y = bX + c \qquad (2)$$

where:

b is the slope and
c is the intercept.

It also contains the standard error of estimate associated with the equation. Columns 41-70 contain similar data to predict mass from the length variable.

The regression data used in the following examples are unpublished data provided by the USAF. This report contains the slope, intercept, and standard error in metric units.

The coefficients are multiplied by appropriate factors to convert them to the English units specified on the Variable Definition Card. The regression equation to predict sitting height in inches from weight in pounds would be:

Estimated Sitting Height = 0.02669 x Actual Weight + 32.05275
(Variable #2) (Variable #1)

(1)

The standard error would be 1.11161.

The equation to predict weight in pounds from sitting height in inches is:

Estimated Weight = 7.84538 x Actual Sitting Height - 114.20831

(2)

The standard error would be 19.05910.

In Figure 49 (2), the "1" in column 3 identifies Weight as the mass related variable, and the "2" in column 6 identifies Sitting Height as the length related variable. The regression coefficients for equations (1) and (2) are punched in the remainder of the card.

The second record format is shown in Figure 48c and defines the multiple regression information necessary to predict each dependent variable from the particular combination of mass and length related variables. Columns 1-3 define the independent mass variable number; columns 4-6 define the independent variable number; and columns 7-9 define the dependent variable number. Each integer value must be right-justified. Columns 11-20 define the slope associated with the mass variable value (b_1); columns 21-30 define the slope for the length variable value (b_2); and columns 31-40 define the constant of the equation (c). The equation form is:

$$Y = b_1X_1 + b_2X_2 + c \qquad (3)$$

where:

X_1 is the value of mass related variable;

```
+ADD R67 USAF     0   17   24   12
  1 WEIGHT                LB    1          1
  2 SITTING HEIGHT        IN          1    1                                                    (1)
  3 EYE HGT/SITTING       IN          1
  4 ACROMION HGT/SIT      IN               1
  5 KNEE HGT/SITTING      IN          1    1
  6 BUTTOCK-KNEE LGTH     IN          1    1
  7 SHOULDR-ELB LGTH      IN               1
  8 ELBOW-GRIP LGTH       IN          1
  9 THUMB-TIP REACH       IN          1
 10 BIACROMIAL BRDTH      IN               1
 11 BIDELTOID BRDTH       IN     1
 12 HIP BREADTH           IN               1
 13 HIP BREADTH/SITT      IN     1
 14 CHEST DEPTH           IN     1         1
 15 FOOT LENGTH           IN               1
 16 HAND LENGTH           IN               1
 17 ELBOW-WRIST LGTH      IN               1
  1  2          0.02669   32.05275   1.11161   7.84538-114.20831   19.05910                    (2)
  1  2  1  1.0            0.0        0.0
  1  2  2  0.0            1.0000000  0.0
  1  2  4  0.0076260      0.6716000  -1.92387
  1  2  5  0.0175512      0.2668000   9.12241                                                   (3)
  1  2  6  0.0286654      0.1086000  14.82459
  1  2  7  0.0075787      0.1875000   5.95968
  1  2 10  0.0131732      0.1105000   9.09417
  1  2 12  0.0279173      0.0043000   8.67957
  1  2 14  0.0313031     -0.1665000  10.32958
  1  2 15  0.0069724      0.1246000   4.85468
  1  2 16  0.0034882      0.0892000   3.84523
  1  2 17  0.0070         0.14032     5.43352
  1  3          0.02287   27.89858   1.08116   7.45657 -84.02761   19.52158
  1  3  1  1.0            0.0        0.0
  1  3  2                 0.979      5.484241
```

Figure 49. Example of Regression, or Type 0, Member.

X_2 is the value of length related variable; and

Y is the value of predicted dependent variable.

The data for this card are derived from the correlation matrices shown in Tables 8 and 9, and from the equations in Zeigen, et al, (December 1960). As an example, the multiple regression equation to predict Knee Height/Sitting from Weight and Sitting Height is as follows:

Knee Height/Sitting = 0.0175512 x Weight (Variable #1)
+ 0.2668000 x Sitting Height (Variable #2)
+ 9.12241

The third outlined area of Figure 49 shows how this example would be punched. A "1" in column 3 identifies Weight as the mass variable; a "2" in column 6 identifies Sitting Height as the length variable; and a "5" in column 9 identifies Knee Height/ Sitting as the dependent variable. The regression coefficients are punched in the remainder of the card.

If the number of multiple regression coefficient definition data cards is not equal to (ncmb x ndep) the member is not added to the Anthropometric Data Base.

4.3.2.3 TYPE 1 MEMBERS

For type 1 members on the Data Base, sample record formats are shown in Figure 50a and 50b. The format in Figure 50a defines the percentile names for which values are supplied in succeeding cards. Figure 51(1) shows the percentile names for the 1967 USAF Survey. The 25 percentile values available for this survey include the 1^{st}, 2^{nd}, 3^{rd}, 5^{th}, punched in a two-digit integer field, right-justified within the area. The number of percentiles supplied must equal the value of the npct field of the +ADD (type 1) control card, or an error message is printed and the member is not added. The maximum number of percentiles allowed is 30.

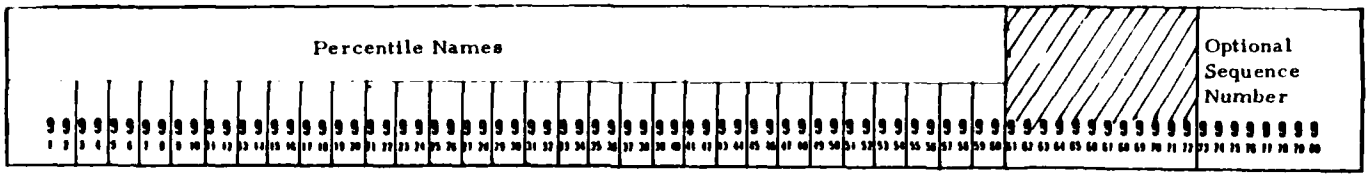


Figure 50a. Program CBMAM Survey Member Percentile Definition Card.

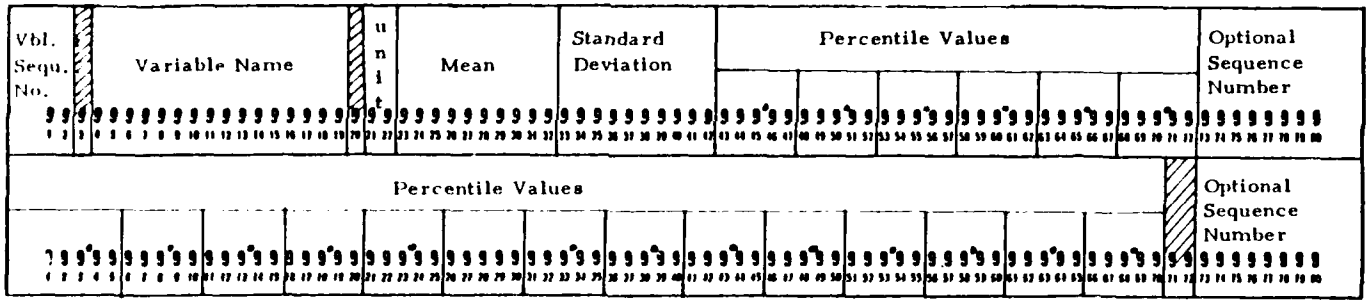


Figure 50b. Program CBMAM Survey Member Dimension Definition Cards.

```
+ADD 67 USAF     1  17  24  12  25  R67 USAF
  1 2 3 5101520253035404550556065707580859095979899                    (1)
  1 WEIGHT              LB 173.60686 21.434704127581326313562140151468915153
1552715850161561643716708169741724217513177921608418397187411913219591  (2)
20183210762166222094227 73
  2 SITTING HEIGHT    IN 36.635332 1.2501624 3394 3424 3444 3470 3511 3539
  3562 3582 3600 3617 3633 3649 3665 3681 3696 3713 3733 3755 3775 3801
  3833 3880 3910 3931 3962
  3 EYE HGT/SITTING   IN 31.869176 1.1671142 2917 2950 2971 2998 3036 3065
  3087 3106 3123 3138 3153 3168 3183 3198 3213 3229 3246 3265 3285 3311
  3343 3390 3421 3443 3478
  4 ACROMION HGT/SIT IN 24.03821  1.123410  2142 2177 2197 2224 2263 2289
  2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522
  2551 2594 2620 2639 2666
  5 KNEE HGT/SITTING IN 21.95673   .98641   1973 1996 2015 2037 2071 2095
  2113 2129 2143 2157 2169 2182 2194 2206 2219 2231 2245 2260 2277 2296
  2322 2360 2386 2405 2436
  6 BUTTOCK-KNE LGTH IN 23.78431  1.06204   2130 2165 2183 2207 2244 2269
  2289 2306 2322 2336 2350 2363 2376 2389 2402 2416 2431 2447 2465 2486
  2514 2557 2587 2610 2648
  7 SHOULDR-ELB LGTH IN 14.15362   .674011  1265 1281 1291 1306 1329 1345
```

Figure 51. Example of Survey, or Type 1, Member.

Figure 50b shows the format used in assigning dimensional values to the various variables. The integer variable number is in columns 1-2, while columns 4-19 contain the 16-character variable name. Columns 21-22 contain the two character abbreviation for the default unit of measurement. At present the default or standard unit for weight is pounds, and the standard unit for all other measurements is inches. For each variable number, the variable name and unit of measurement must correspond exactly with the same fields in the referenced type 0 or regression member. Columns 23-32 contain the overall mean for the named variable, in the default unit of measurement. Columns 33-42 contain the standard deviation. Columns 43-72 and 1-70 of as many additional cards as necessary contain the values for each of the percentiles named. If the number of percentile values does not correspond to the value of npct, an error condition occurs and the member is not added to the Data Base. The period in the fields in Figure 50a and 50b indicate the standard or default location of the decimal point in the real numbers.

The dimension data needed in this card were also obtained from the Summary Statistics of the 1967 Survey (Churchill et al, 1976). A sample of this data for Weight is shown in Figure 45. The mean value of Weight, 173.60686 lbs, the standard deviation, 21.434704, and the weight associated with the first six percentiles (1^{st}, 2^{nd}, 3^{rd}, 5^{th}, 10^{th}, 15^{th}) are punched on the first card shown in Figure 51(2). The weight values for the 20^{th} thru the 85^{th} percentiles, 90^{th} thru 99^{th}, are punched in the last card. It is essential that the user enter a type 0 member into the Data Base prior to adding the associated type 1 member, since the type 1 member references the type 0 member.

4.3.2.4 CHECK ANTHROPOMETRIC MEMBER Function

+CHK membername type nvbl ncmb ndep npct regr name

The CHECK ANTHROPOMETRIC MEMBER function operates in the same fashion as the *ADD ANTHROPOMETRIC MEMBER* function does, except the member is not added. The member is only checked for errors.

4.3.2.5 DELETE ANTHROPOMETRIC MEMBER Function

+DEL membername type

The DELETE ANTHROPOMETRIC MEMBER function removes the specified member from the data base, but does not make the space the member occupied available for reuse. The +CMP function must be used to accomplish this.

4.3.2.6 COMPRESS ANTHROPOMETRIC DATA BASE Function

+CMP

The COMPRESS ANTHROPOMETRIC DATA BASE function makes space available for storing anthropometric members by compressing used space together and therefore maximizing the amount of continuous unused space. The intermediate blocks of unused space are created by the DELETE ANTHROPOMETRIC MEMBER function. The greater the activity of the Anthropometric Data Base (i.e., +ADD's and +DEL's), the more often it becomes necessary to use this +CMP function. If the message "CBM310A INSUFFICIENT SPACE REMAINING TO ADD MEMBER membername" appears when you try to add a member, it becomes necessary to use the +CMP function. If the +ADD function gives the CBM310A message immediately following the +CMP function, the Data Base is full and no new members can be added until an existing member is deleted, or more space is added.

4.3.2.7 DUMP ANTHROPOMETRIC MEMBER Function

+DMP membername type

+DMP

The DUMP ANTHROPOMETRIC MEMBER function prints the contents of the anthropometric member membername of type specified, or prints the complete Anthropometric Data Base if no member name is given on the control card. This function is used primarily by system programmers to check the contents of the file.

4.3.2.8 END PROGRAM Function

+END

The END PROGRAM function control card terminates execution of the program CBMAM and returns control to the operating system.

4.3.2.9 INITIALIZE ANTHROPOMETRIC DATA BASE Function

+INT

The INITIALIZE ANTHROPOMETRIC DATA BASE function will reset the Data Base to its original unused state. Any members that were on the Data Base before the function was invoked will be purged, and all the space will be available for new members. The primary purpose of this function is to establish a Data Base.

4.3.2.10 PUNCH ANTHROPOMETRIC MEMBER Function

+PCH membername type

The PUNCH ANTHROPOMETRIC MEMBER function will punch a copy of the specified member in the same format the ADD ANTHROPOMETRIC MEMBER function requires for the specified type. The member is punched onto computer cards. Specifying a member name that does not exist causes a printout of the member names that are on the Data Base. This function does not remove the member from the Data Base.

```
//CBMAM    JOB MESS                                                  00001500
//JOBLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR                          00001100
//CBMAM    EXEC PGM=CBMAM                                            00001200
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,DISP=SHR                         00001300
//FT05F001 DD DDNAME=SYSIN                                           00001400
//FT06F001 DD SYSOUT=A                                               00001500
//FT07F001 DD SYSOUT=B                                               00001600
//SYSUDUMP DD SYSOUT=A                                               00001700
//SYSIN    DD *                                                      00001800

          CBMAM FUNCTION CONTROL CARDS AND
             MEMBER DEFINITION DATA

/*                                                                   00001900
//
```

Figure 52. Job Control Cards to Execute CBMAM.

```
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,UNIT=DISK,DISP=(NEW,CATLG),      00001300
//            VOL=SER=DISK01,SPACE=(248,2000),                       00001310
//            DCB=(BLKSIZE=248,LRECL=248,RECFM=FB)                   00001320
```

Figure 53. FT02 DD Card to Allocate Space for COMBIMAN.ANTHDTA and Execute CBMVM.

4.3.2.11 PRINT ANTHROPOMETRIC MEMBER Function

+PRT membername type
+PRT

The PRINT ANTHROPOMETRIC MEMBER function will print the contents of the specified member, membername, of type, type, in a format similar to that used in the ADD ANTHROPOMETRIC MEMBER function. Specifying no name, or a name that is not in the Data Base causes a printout of the member names in the Data Base, the number of records the member occupy in the Data Base, the type, and any additional data as supplied on the +ADD control card when the members were added to the Data Base.

4.3.3 Submitting a Processing Request

In submitting a processing request for the program CBMAM, the user must use a predetermined set of Job Control Language Cards (JCL) which calls the program CBMAM and defines the files used (such as the Data Base itself). Located within this deck of JCL cards are the program function control cards and any related member definition cards. The set of JCL used at HESS facility is shown in Figure 52. Use of the card which begins //FT02F001 as shown in Figure 52 assumes that the space on disk for the Data Base has already been allocated. If for some reason this condition is not met, the //FT02F001 DD card in Figure 52 should be replaced by the card sequence shown in Figure 53. The JCL deck should be run with this replacement series only once - enough to allocate the space for the file on disk, and to catalogue the file in the system library. Thereafter the simplified "//FT02F001 DD" card shown in Figure 52 should be used.

If the file has just been created, or if the user wants to reinitialize the file, the +INT control function should be used before any other control card function.

The last control card read into the program should be the +END control card.

4.3.4 Interpreting the Output Data

The program CBMAM generates output to the card punch, to the disk file, or to the printer depending on the control card function specified. The formats for the printed output will be discussed in this section. Punched records use the same format as the input data records discussed in Paragraph 4.3.2.

Five basic types of formats are used by CBMAM when writing data on the printer. Each of these format types, their use, and an example of each will be presented in the following paragraphs. Each of the types begin with the same heading, listing the program name, CBMAM, the date and time of the program execution, and a page number.

The first type of output is generated by the INITIALIZE, PUNCH, COMPRESS, DELETE, and END functions. The output informs the user of the start and end of processing associated with the function specified. For the COMPRESS function, additional messages are supplied indicating that a particular member was or was not moved in the process of compressing unused records. An example of this format for the COMPRESS function is shown in Figure 54.

The second type of output is generated by the PRINT or PUNCH functions when the +PRT or +PCH control cards are supplied with a blank membername field. This causes a listing of the index of the Data Base. The location and type of each member is contained on the index as one record. This information is printed in the following format:

nn.) membername, EXTENT = (n1, n2), TYPE = tt,
nv VARIABLES, nc COMB OF INDEP, nd DEPENDENT,
np PERCENTILES, r-membername REFERENCED SURVEY.

where:

nn is the record number of this identification record within the directory.

n1 is the location of the first record of data which defines this member.

```
CB4430I +CMP R67 USAF
CB4435I R67 USAF WAS IN PLACE.
CB4435I 67 USAF  WAS IN PLACE.
CB4436I COMPRESS FINISHED.
CB4399I PROGRAM END.
```

Figure 54. A Sample Output of the +CMP Function.

n2 is the location of the last record of data which defines this member.

tt is the type code (0 or 1).

nv is the total number of anthropometric variables defined.

nc is the number of combinations of independent variables.

nd is the number of dependent variables.

np is the number of percentiles (np = 0 if tt = 0).

r-membername is the name of the referenced regression member (r-membername is blank if tt = 0).

This information was originally supplied to the Data Base on the +ADD control card. An example of the usage of the PRINT function is shown in Figure 55.

The third type of output is generated by the DUMP function. This function is used primarily by systems programmers to locate causes of I/O (Input/Output) errors on the Data Base. For the member specified on the +DMP Control Card, a message giving directory or index information is printed, using the output format previously described for the +PRT control card. Each record associated with the member is then printed in the following format:

```
RECORD nnn + = + (record in EBCDIC)                    + = +
  + = + (record in hexadecimal)                        + = +
  + = + (remainder of record in hexadecimal)           + = +
```

where nnn is the location of the record in the Data Base. The record in EBCDIC is printed using a 25A4 format. The record in hexadecimal is printed using a 10Z8 format. An example of the DUMP function is shown in Figure 56.

The fourth output format is used by the CHECK, ADD, and PRINT functions when a type 0, or regression member is specified. After reading the control card and checking it for errors, the information contained on the control card is reformatted and written out to the printer.

```
C4AM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM          2/29/80  13.55.  0  PAGE   1

COMMAND: +PRT
          20.) 67 USAF , EXTENT=(  63,  807, TYPE= 1, 17 VARIABLES, 24 COMB OF INDEP, 12 DEPENDENT, 25 PERCENTILES,
                         R67 USAF REFERENCED SURVEY.
          21.) R67 USAF, EXTENT=(  22,  621, TYPE= 0, 17 VARIABLES, 24 COMB OF INDEP, 12 DEPENDENT,  0 PERCENTILES,
                         REFERENCED SURVEY.
```

Figure 55. A Sample Output of the +PRT Function.

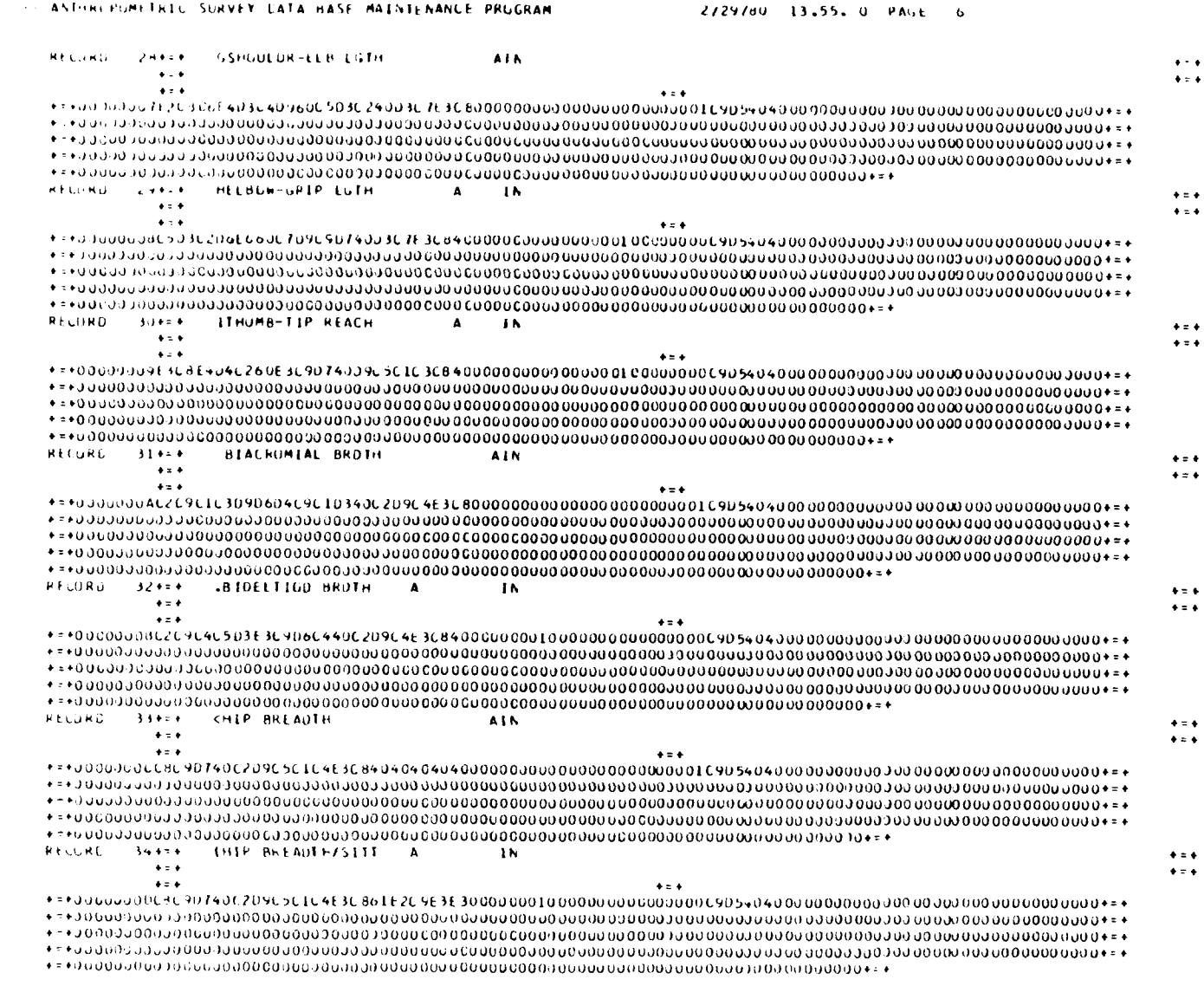


Figure 56. A Sample Output of the +DMP Function.

Following the control card information, each Variable Definition Card is printed. The format used for printing the Variable Definition Card is as follows:

nn.) variablename, INDEP VBLS (MASS = ns, LENGTH = ns),
DEP VBL = ns, UNIT OF MEASUREMENT = uu

where

nn is the variable number

variablename is the 16 character name of the variable

ns 0 means No; 1 means Yes

uu is the unit of measurement assigned to the variable: either IN, CM, MM, LB, or KG.

After the variable definition data, the regression data for each combination of independent variables are printed. The format is shown in Figure 57. The terms are defined as follows:

n1	is the variable number for the mass-related variable
mass name	is the variable name for the mass-related variable
n2	is the variable number for the length-related variable
length name	is the variable name for the length-related variable
$bb.bbb_1$, $bb.bbb_2$	is the slope used to predict (1) length variable from mass variable, and (2) mass variable from length variable
$cc.ccc_1$, $cc.ccc_2$	is the constant used to predict (1) length variable from mass variable, and (2) mass variable from length variable
$ss.sss_1$, $ss.sss_2$	is the standard error of the estimate of the equations
nd_1 - nd_{ndep}	are the variable numbers for the dependent variables
$depname_1$ - $depname_{ndep}$	are the variable names for the dependent variables

INDEPENDENT VARIABLES (MASS & LENGTH)	DEPENDENT VARIABLE	REGRESSION COEFFICIENTS (B1, B2, CNST)		
n1 mass name n2 length name	SIMPLE REGR (B1, CNST, SE) -	LENGTH FROM MASS	bb.bbb$_1$	cc.ccc$_1$ ss.sss$_1$
		MASS FROM LENGTH	bb.bbb$_2$	cc.ccc$_2$ ss.sss$_2$
	nd$_1$ dep vbl name$_1$	bb.bbbbb$^1_1$	bb.bbbbb$^2_1$	cc.ccccc$_1$
	⋮ ⋮	⋮	⋮	⋮
	nd$_{ndep}$ dep vbl name$_{ndep}$	bb.bbbbb$^1_{ndep}$	bb.bbbbb$^2_{ndep}$	cc.ccccc$_{ndep}$

Figure 57. Output Format Used for Type 0 Regression Data.

$bb.bbbbb^1_1$ - $bb.bbbbb^1_{ndep}$ } is the slope for the mass variable when predicting dependent $variable_i$, where i = 1, ndep

$bb.bbbbb^2_1$ - $bb.bbbbb^2_{ndep}$ } is the slope for the length variable when predicting dependent $variable_i$, where i = 1, ndep

$cc.ccccc_1$ - $cc.ccccc_{ndep}$ } is the constant for the multiple regression equation to predict dependent $variable_i$, where i = 1, ndep.

An example of the output in the fourth format for the +ADD control card is shown in Figure 58a and 58b.

The fifth output format is also used by the CHECF, ADD and PRINT functions, but only when the type code is 1, signifying a survey member. After reading the control card and checking it for errors, the information on the card relevant to the number of records written to the Data Base is reformatted and printed out.

Following the control card information, the percentile names (such as 1, 2, 3, 50, 95, etc.) for the member are printed as part of a subheading. A maximum of 10 percentile names are printed on one line. The survey data are then printed in the following format:

nn.) variablename uu mmm.mm ss.sss $ppp.pp_1$ ... $ppp.pp_{10}$
$ppp.pp_{11}$ ... $ppp.pp_{20}$
$ppp.pp_{21}$ ... $ppp.pp_{npct}$

where

nn	is the variable number
variablename	is the name of the anthropometric variable
uu	is the specified unit of measurement for the variable
mmm.mm	is the mean value for the variable
ss.sss	is the standard deviation for the variable

```
C.RAM -- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM          2/29/80  13.49.37  PAGE   2

  TOTAL MALE RG7 SAV  0 17 24 12  0
 C TOTAL MEMBER RG7 SAV IS TYPE 0 AND CONTAINS 17 ANTHROPOMETRIC VARIABLE NAMES.
  TOTAL MEMBER ALSO CONTAINS 16 ADDITIONAL RECORDS, EACH CONTAINING THE REGRESSION COEFFICIENTS FOR 12 DEPENDENT VARIABLES.
              1.) WEIGHT           , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= LB
              2.) SITTING HEIGHT   , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, UNIT OF MEASUREMENT= IN
              3.) EYE HGT/SITTING  , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, UNIT OF MEASUREMENT= IN
              4.) ACROMION HGT/SIT, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
              5.) KNEE HGT/SITTING, INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, UNIT OF MEASUREMENT= IN
              6.) BUTTOCK-KNE LGTH, INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, UNIT OF MEASUREMENT= IN
              7.) SHOULDR-ELB LGTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
              8.) ELBOW-GRIP LGTH  , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, UNIT OF MEASUREMENT= IN
              9.) THUMB-TIP REACH  , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, UNIT OF MEASUREMENT= IN
             10.) BIACROMIAL BRDTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
             11.) BIDELTOID BRDTH , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 0, UNIT OF MEASUREMENT= IN
             12.) HIP BREADTH      , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
             13.) HIP BREADTH/SITT, INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 0, UNIT OF MEASUREMENT= IN
             14.) CHEST DEPTH      , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
             15.) FOOT LENGTH      , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
             16.) HAND LENGTH      , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
             17.) ELBOW-WRIST LGTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN

             INDEPENDENT VARIABLES (MASS & LENGTH)     DEPENDENT VARIABLE      REGRESSION COEFFICIENTS (B1, B2, CNST)

              1 WEIGHT              2 SITTING HEIGHT   SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS     0.027  32.053    1.112
                                                                          MASS       LENGTH    7.645-114.208  19.055
                                                  1 WEIGHT             1.00000    0.0        0.0
                                                  2 SITTING HEIGHT     0.0        1.00000    0.0
                                                  4 ACROMION HGT/SIT   0.00763    0.67150   -1.92387
                                                  5 KNEE HGT/SITTING   0.01755    0.26680    9.12241
                                                  6 BUTTOCK-KNE LGTH   0.02867    0.10860   14.82459
                                                  7 SHOULDR-ELB LGTH   0.00758    0.18750    5.95368
                                                 10 BIACROMIAL BRDTH   0.01317    0.11050    9.69417
                                                 12 HIP BREADTH        0.02792    0.00440    8.87957
                                                 14 CHEST DEPTH        0.03130   -0.16650   10.32958
                                                 15 FOOT LENGTH        0.00697    0.12480    4.85468
                                                 16 HAND LENGTH        0.00349    0.08920    3.64523
                                                 17 ELBOW-WRIST LGTH   0.00700    0.14032    5.44352
```

Figure 58a. A Sample Output of the +ADD Function for Type 1 Member.

INDEPENDENT VARIABLES (MASS & LENGTH)	DEPENDENT VARIABLE	REGRESSION COEFFICIENTS (B1, B2, CNST)					
1 WEIGHT	3 EYE HGT/SITTING	SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS			0.023	27.899	1.081
		MASS		LENGTH	7.457	-64.028	19.522
	1 WEIGHT	1.00000	0.0	0.0			
	2 SITTING HEIGHT	0.0	0.97900	5.48424			
	4 ACROMION HGT/SIT	0.0	0.73700	0.55118			
	5 KNEE HGT/SITTING	0.01862	0.26460	10.29247			
	6 BUTTOCK-KNE LGTH	0.0	0.34900	12.66139			
	7 SHOULDR-ELB LGTH	0.00798	0.20110	6.35904			
	10 BIACROMIAL BRDTH	0.01416	0.08370	10.84526			
	12 HIP BREADTH	0.02782	0.00930	8.75802			
	14 CHEST DEPTH	0.03049	-0.15370	9.41976			
	15 FOOT LENGTH	0.00752	0.12150	5.46532			
	16 HAND LENGTH	0.00395	0.08370	4.16954			
	17 ELBOW-WRIST LGTH	0.00819	0.11474	6.73165			
1 WEIGHT	5 KNEE HGT/SITTING	SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS			0.025	17.666	0.827
		MASS		LENGTH	11.762	-84.611	18.054
	1 WEIGHT	1.00000	0.0	0.0			
	2 SITTING HEIGHT	0.01474	0.48200	23.54442			
	4 ACROMION HGT/SIT	0.01821	0.29590	14.37994			
	5 KNEE HGT/SITTING	0.0	1.00000	0.0			
	6 BUTTOCK-KNE LGTH	0.01491	0.67910	6.37341			
	7 SHOULDR-ELB LGTH	-0.00020	0.51800	2.81440			
	10 BIACROMIAL BRDTH	0.01256	0.14420	10.66774			
	12 HIP BREADTH	0.02823	-0.00810	9.16118			
	14 CHEST DEPTH	0.03019	-0.13470	7.37230			
	15 FOOT LENGTH	0.00303	0.23470	3.64691			
	16 HAND LENGTH	0.00078	0.20610	2.80251			
	17 ELBOW-WRIST LGTH	-0.00029	0.45137	1.75212			
1 WEIGHT	6 BUTTOCK-KNE LGTH	SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS			0.032	18.299	0.821
		MASS		LENGTH	12.813	-131.085	16.540
	1 WEIGHT	1.00000	0.0	0.0			
	2 SITTING HEIGHT	0.02033	0.19750	28.41289			
	4 ACROMION HGT/SIT	0.02389	0.05110	18.67545			
	5 KNEE HGT/SITTING	0.00330	0.64530	5.11351			
	6 BUTTOCK-KNE LGTH	0.0	1.00300	0.0			
	7 SHOULDR-ELB LGTH	-0.00232	0.47190	3.33250			
	10 BIACROMIAL BRDTH	0.01541	0.03770	13.06510			
	12 HIP BREADTH	0.02673	0.04120	8.26378			
	14 CHEST DEPTH	0.02938	-0.07950	6.44568			
	15 FOOT LENGTH	0.00338	0.21320	4.84350			
	16 HAND LENGTH	0.00139	0.15100	3.74169			
	17 ELBOW-WRIST LGTH	0.00053	0.32454	4.00511			

Figure 58b. A Sample Output of the +ADD Function for Type 1 Member.

$ppp.pp_1$ - $ppp.pp_{npct}$ } are the percentile values associated with the percentile names for the anthropometric variables

An example of this fifth format is shown in Figure 59a-b.

4.4 PROGRAM MESSAGES INCLUDING ERROR CORRECTION

The program CBMAM prints out both information and action related messages. The message format is as follows:

CBM3nni messagetext

where:

nn	is the message number
i	identifies the action code (I-informational, A = action to be performed), and
messagetext	is the text of the message.

Unless otherwise noted, all messages are issued by the routine CBMAM.

CBM300I Control card image (e.g. +ADD, +PRT, etc.)
Reason: The user submitted a control card.
System Action: None.
User Action: None.

CBM301A Operation - UNKNOWN OPERATION.
Reason: The operation on the control card (shown in the previous CBM300I Message) is unknown.
System Action: The control card is ignored.
User Action: Correct card, using a valid operation, and resubmit.

CBM302I INITIALIZED.
Reason: The user requested that the Anthropometric data base be initialized using the Initialized Anthropometric Data Base Function (+INT).
System Action: The data base is initialized.
User Action: None.

CBM303A NO NAME GIVEN; operation IGNORED.
Reason: The operation specified on the control card requires a membername; but no name was supplied.
System Action: The control card and subsequent data, if any, are ignored.
User Action: Correct the card, adding the appropriate additional information as required in the definition of the specific operation, and resubmit.

DATA SET NAME 67 USAF 1 17 29 12 29 867 USAF
DATA SET MEMBER 67 USAF IS TYPE 1 AND CONTAINS 17 ANTHROPOMETRIC VARIABLE NAMES.

NO.	VARIABLE NAME	UNIT	MEAN	STDV	PERCENTILES									
					1	2	3	5	10	15	20	25	32	35
					40	45	50	55	60	65	70	75	80	85
					90	95	97	98	99					
1.)	WEIGHT	LB	173.61	21.435	127.58	132.83	135.82	140.15	146.89	151.53	155.27	158.36	161.06	164.37
					167.08	169.74	172.42	175.13	177.92	180.84	183.97	187.41	191.32	195.71
					201.83	210.76	216.62	220.94	227.73					
2.)	SITTING HEIGHT	IN	36.69	1.250	33.94	34.24	34.40	34.70	35.11	35.39	35.62	35.82	36.01	36.17
					36.33	36.49	36.65	36.81	36.98	37.15	37.33	37.53	37.75	38.01
					38.33	38.60	39.10	39.31	39.62					
3.)	EYE HGT/SITTING	IN	31.87	1.187	29.17	29.50	29.71	29.98	30.38	30.65	30.87	31.05	31.23	31.36
					31.53	31.68	31.83	31.98	32.13	32.29	32.46	32.65	32.86	33.11
					33.43	33.90	34.21	34.43	34.78					
4.)	ACROMION HGT/SIT	IN	24.04	1.123	21.42	21.77	21.97	22.24	22.63	22.89	23.10	23.27	23.43	23.54
					23.73	23.87	24.01	24.15	24.30	24.45	24.61	24.79	24.99	25.22
					25.51	25.94	26.20	26.39	26.66					
5.)	KNEE HGT/SITTING	IN	21.96	0.980	19.73	19.98	20.13	20.37	20.71	20.95	21.13	21.29	21.43	21.57
					21.69	21.82	21.94	22.06	22.19	22.31	22.45	22.60	22.77	22.96
					23.22	23.60	23.86	24.05	24.36					
6.)	BUTTOCK-KNE LGTH	IN	23.78	1.062	21.33	21.65	21.83	22.07	22.44	22.69	22.85	23.00	23.12	23.23
					23.50	23.63	23.76	23.87	24.02	24.16	24.31	24.47	24.64	24.85
					25.14	25.57	25.87	26.10	26.48					
7.)	SHLDR-ELB LGTH	IN	14.15	0.674	12.65	12.81	12.91	13.06	13.29	13.45	13.57	13.68	13.79	13.88
					13.97	14.06	14.14	14.23	14.32	14.41	14.51	14.61	14.73	14.86
					15.03	15.28	15.44	15.55	15.73					
8.)	ELBOW-FOREP LGTH	IN	13.46	0.636	12.47	12.61	12.70	12.83	13.04	13.19	13.31	13.42	13.51	13.60
					13.69	13.77	13.85	13.93	14.01	14.10	14.19	14.29	14.41	14.57
					14.69	14.93	15.09	15.21	15.40					
9.)	THUMB-TIP REACH	IN	31.62	1.565	28.09	28.46	28.72	29.03	29.64	30.01	30.30	30.56	30.79	31.03
					31.29	31.59	31.78	31.98	32.18	32.40	32.64	32.91	33.22	
					33.99	34.27	34.64	35.02	35.55					
10.)	BIACROMIAL BRDTH	IN	16.03	0.764	14.18	14.41	14.56	14.75	15.03	15.25	15.41	15.54	15.65	15.76
					15.86	15.96	16.05	16.14	16.24	16.33	16.43	16.54	16.67	16.83
					16.93	17.20	17.44	17.53	17.72					
11.)	SHOULDER CIRCUM	IN	16.53	1.008	14.67	14.96	15.14	15.37	15.72	15.97	16.14	16.31	16.44	16.55
					16.71	16.84	16.96	17.07	17.22	17.36	17.51	17.67	17.84	18.05
					18.32	18.71	18.97	19.15	19.42					
12.)	HIP BREADTH	IN	13.39	0.742	12.21	12.41	12.54	12.71	12.97	13.14	13.28	13.39	13.49	13.59
					13.68	13.77	13.86	13.95	14.04	14.13	14.23	14.33	14.47	14.63
					14.92	15.15	15.37	15.57	15.89					

Figure 59. A Sample Output of the +ADD Function for Type 0 Member.

CBM304A TYPE SPECIFICATION INVALID FOR MEMBER membername.
Reason: An invalid type code, that is, a type code other than 0 or 1, was given for the specified member.
System Action: Control card, and any subsequent data, are ignored.
User Action: Correct code and resubmit.

CBM305A NUMBER OF ANTHROPOMETRIC DIMENSIONS INVALID FOR MEMBER membername.
Reason: The number of anthropometric dimensions specified for the given member on either the +ADD or +CHK control card was either less than one or greater than 45.
System Action: Control card and any subsequent data are ignored.
User Action: Correct value and resubmit.

CBM306A NUMBER OF COMBINATIONS OF INDEPENDENT VARIABLES INVALID FOR MEMBER membername.
Reason: The number of combinations of independent variables (the product of the number of mass related variables and the number of length related variables) for the +ADD or +CHK control card is less than one or greater than 50, for the member specified.
System Action: The control card and any subsequent data are ignored.
User Action: Correct the card and resubmit.

CBM307A NUMBER OF DEPENDENT VARIABLES INVALID FOR MEMBER membername.
Reason: The number of dependent variables specified on the +ADD or +CHK control card was less than one or greater than 30 for the indicated member.
System Action: The control card and any subsequent data are ignored.
User Action: Correct the card and resubmit.

CBM308A NUMBER OF PERCENTILES INVALID FOR MEMBER membername.
Reason: The number of percentiles specified on the +ADD or +CHK control card was less than one or greater than 30 for the indicated member.
System Action: The control card and subsequent data are ignored.
User Action: Correct the number and resubmit.

CBM309A ILLEGAL CONTROL CARD FOR MEMBER membername DUE TO nn ERRORS.
Reason: Control card format invalid. The system found nn errors.
System Action: Control card and subsequent data cards are ignored.
User Action: Correct the card and resubmit.

CBM310A INSUFFICIENT SPACE REMAINING TO ADD MEMBER membername.
Reason: The Data Base does not have sufficient continuous space to add the specified member.
System Action: The member is not added to the data base.
User Action: Run the program CBMAM with the +CMP control card, followed by the request to add the specified member. If the CBM310A message reappears, members will have to be deleted (using the +DEL function) before adding new member.

CBM311A DIRECTORY IS FULL, CANNOT ADD membername.
Reason: The Data Base directory, which contains the location of each member within the file, can hold a maximum of 20 entries. The member specified would be 21, and cannot be added.
System Action: The member is not added to the Data Base.
User Action: A member will have to be deleted before adding a new member.

CBM312A MEMBER membername IS NOT FOUND IN THE DIRECTORY.
Reason: The type 0 member membername which was referenced by the type 1 member is not in the directory.
System Action: The control card and data are ignored.
User Action: Check that the type 0 member was specified.

CBM313I MEMBER, membername IS TYPE tt AND CONTAINS nn ANTHROPOMETRIC VARIABLE NAMES.
Reason: The +ADD or +CHK control card has been read in for the specified member, and the type field and the number of variables have been accepted.
System Action: None.
User Action: None.

CBM314I MEMBER ALSO CONTAINS nn ADDITIONAL RECORDS, EACH CONTAINING THE REGRESSION COEFFICIENTS FOR mm DEPENDENT VARIABLES.
Reason: Message is printed for +ADD or +CHK control card for type 0 members. It provides information on the number of additional records associated with the previously specified member.
System Action: None.
User Action: None.

CBM315A VARIABLE variablename1 HAS THE SAME NUMBER AS VARIABLE variablename2.
Reason: Each variable entered as part of a type 0 or type 1 member must have a unique number.
System Action: Record which defines variablename1 is flagged as containing an error. Member may not be added.
User Action: Correct number and reenter member.

CBM316A variable name USED IN VARIABLES n1 AND n2.
Reason: Each variable number must have a unique variable name.
System Action: Record which contains variable number n2 is flagged as containing an error. Member may not be added.
User Action: Correct record and reenter member.

CBM317A variable name IS NEITHER DEPENDENT OR INDEPENDENT.
Reason: An anthropometric variable must be defined as either dependent, that is one necessary for the creation of the link system of the model, or independent, that is a variable highly correlated to body segment mass or body segment length. This variable has not been flagged as either.
System Action: The record is flagged as containing an error, and the member may not be added to the data base.
User Action: Punch a "1" in either column 16, 30, or 34, depending on the type of variable and resubmit.

CBM318A variable name IS INDEPENDENT VARIABLE FOR BOTH MASS AND LENGTH.
Reason: An anthropometric variable may be an independent variable correlated to either mass or length, but not both.
System Action: The record is flagged as containing an error, and the member may not be added to the Data Base.
User Action: Delete the entry "1" from either column 26 or 30 and resubmit.

CBM319A MEMBER membername CONTAINS TOO MANY INDEPENDENT VARIABLES.
Reason: The number of combinations of independent variables (number of mass variables x number of length variables) encountered must be equal to the number of combinations specified on the +ADD or +CHK control card.
System Action: Member is not added to Data Base.
User Action: Verify the totals, make the appropriate corrections, and resubmit.

CBM320A MEMBER membername CONTAINS TOO MANY DEPENDENT VARIABLES.
Reason: The number of dependent variables encountered must be equal to the number of dependent variables specified on the +ADD or +CHK control card.
System Action: Member is not added to the Data Base.
User Action: Verify the total, make appropriate corrections, and resubmit.

CBM321A UNIT OF MEASUREMENT, uu FOR VARIABLE variable name IS NOT PERMISSIBLE.
Reason: Valid units of measurement are IN, CM, MM, LB, and KG.
System Action: The record is flagged and the member is not added to the Data Base.
User Action: Supply a valid unit of measurement, and resubmit.

CBM322A DATA CARD IMAGE multiple regression coefficient card image OUT OF SEQUENCE
Reason: For each combination of independent variables, a total of NDEP + 1 records must be supplied, each beginning with the same two variable numbers specifying the mass and length variable.
System Action: The record is flagged and the member is not added to the Data Base.
User Action: Correct the error and resubmit.

CBM323A VARIABLE variable name IS NOT AN INDEPENDENT VARIABLE PERTAINING TO MASS.
Reason: The variable number supplied in column 1-3 of the regression data cards should correspond to a variable name defined as a mass related independent variable on one of the anthropometric variable definition cards. (See Figure 40)
System Action: The record is flagged and the member is not added to the Data Base.
User Action: Correct the error and resubmit.

CBM324A VARIABLE variable name IS NOT AN INDEPENDENT VARIABLE PERTAINING TO LENGTH.
Reason: The variable number supplied in column 4-6 of the regression definition data cards should correspond to a variable name defined as a length related independent variable on one of the anthropometric variable definition cards. (See Figure 40)
System Action: The record is flagged and the member is not added to the Data Base.
User Action: Correct the error and resubmit.

CBM325A VARIABLE variable name IS NOT A DEPENDENT VARIABLE.
Reason: The variable number supplied in columns 7-9 of the multiple regression data definition cards should correspond to a variable name defined as a dependent variable on one of the anthropometric variable definition cards. (See Figure 40)
System Action: The record is flagged and the member is not added to the Data Base.
User Action: Correct the error and resubmit.

CBM326A VARIABLE nn OUT OF SEQUENCE.
Reason: For a type 1 member definition, the survey definition cards must contain the variable numbers in ascending order.
System Action: The record is flagged and the member is not added to the data base.
User Action: Make necessary corrections and resubmit.

CBM327A variable name IN MEMBER survey membername DOES NOT CORRESPOND TO VARIABLE nn IN regression membername.
Reason: The variable names and numbers in the type 1 member survey membername should correspond exactly to the names and numbers in the referenced type 0 member regression membername.
System Action: The record in the type 1 member definition is flagged and the member is not added to the data base.
User Action: Verify the survey definition variable number and name against the regression, or type 0 member, make necessary corrections, and resubmit.

CBM328A ANTHROPOMETRIC DIMENSION LT OR EQ TO ZERO.
Reason: Dimensions supplied in the survey member definition cards must be positive real numbers.
System Action: The record is flagged and the member is not added.
User Action: Correct and resubmit.

CBM329I MEMBER regression membername, WITH nn ANTHROPOMETRIC VARIABLES AND nn_1 X nn_2 SETS OF REGRESSION EQUATIONS, HAS BEEN ADDED.
Reason: The type 0 member is added to the Data Base.
System Action: The member is added to the Data Base.
User Action: None.

CBM330I MEMBER survey membername, WITH nn ANTHROPOMETRIC VARIABLES AND nn_1 PERCENTILES, AND REFERENCING SURVEY regression membername HAS BEEN ADDED.
Reason: The type 1 member is added to the Data Base.
System Action: The member is added to the Data Base.
User Action: None.

CBM331A membername HAS NOT BEEN ADDED DUE TO nnn ERRORS.
Reason: After checking the member definition, nnn syntax errors were found.
System Action: The member is not added to the Data Base.
User Action: Correct the errors, and resubmit.

CBM332A MEMBER membername CHECKED - nnnnn ERRORS.
Reason: After checking the member definition, nnnnn syntax errors were found.
System Action: None.
User Action: Correct the errors and resubmit.

CBM333I MEMBER membername DELETED.
Reason: User requested +DEL function caused a member to be deleted from the Data Base.
System Action: Member deleted from Data Base.
User Action: None.

CBM334I membername NOW IN PLACE.
Reason: User requested +CMP function caused member to be moved within Data Base, combining unused space.
System Action: Directory index in data base updated.
User Action: None.

CBM335I membername WAS IN PLACE.
Reason: User requested +CMP function found that member membername need not be moved.
System Action: Compression continues.
User Action: None.

CBM336I COMPRESS FINISHED.
Reason: Successful completion of +CMP function.
System Action: None.
User Action: None.

CBM337I membername PUNCHED.
Reason: User initiated +PCH function for member membername successfully completed.
System Action: Punching is completed.
User Action: None.

CBM339A END-OF-DATA.
Reason: End of file found before End Program Control Card (+END) was found.
System Action: End of job.
User Action: Check that all control cards were processed.

CBM340A MEMBER membername ALREADY EXISTS.
Reason: The user has tried to add an anthropometric member definition under a name that already exists in the Data Base.
System Action: The control card is ignored.
User Action: Use a new name and resubmit.

CBM341A DATABASE IS NOT AN ANTHROPOMETRIC DATABASE.
Reason: First record of file does not contain "ANTH" identification field.
System Action: Terminates the program.
User Action: Contact systems programmer.

CBM342A I/O ERROR ON RECORD nnnnn (INDEX).
Reason: An I/O error has occurred in the directory of the Anthropometric Data Base.
System Action: Terminates the program.
User Action: Contact systems programmer.

CBM343A I/O ERROR ON RECORD nnnnn (DATA).
Reason: An I/O error has occurred in a member definition on the Anthropometric Data Base.
System Action: Terminates the program.
User Action: Contact systems programmer.

CBM399I PROGRAM END.
Reason: The +END Control Card was encountered, or the end of input cards was encountered, or there was an I/O error.
System Action: Terminates the program.
User Action: Check that all control cards were accepted, and processed correctly.

SECTION 5

CREW STATION DATA BASE MAINTENANCE PROGRAM (CBMCM)

The COMBIMAN is a very effective tool to evaluate crew stations. These crew stations may already be in use, or may exist only as an engineer's drawing. The best way to make these crew stations available to the man-model in the interactive graphics program CBM04 is to store the three dimensional coordinates of the panels and controls of the crew station on a data base accessed by CBM04. The program CBMCM is developed to assist the user to create and to maintain the Crew Station Data Base. The data flow for the program CBMCM is shown in Figure 60.

The Crew Station Data Base contains definitions which geometrically describe crew stations. Typical crew stations are aircraft cockpits, the driver's area of an automobile, etc. To define a crew station, the user must supply the definition of panels and controls found on and about the defined panels. Each crew station in the Data Base is called a "member", and is referenced by its membername.

5.1 PROCESSING PERFORMED

The program allows the user to create and maintain the Crew Station Data Base. Input supplied by the user, on 80 character computer cards or in card image format (80 character records) on magnetic tape, is read into the program CBMCM and processed according to the user's selection of control card commands. These commands allow the user to add or delete members, print or punch existing members, or list the contents of the Data Base. It can also be used to compress the members within the Data Base.

The control cards for CBMCM may be input in any order with one exception. If the Data Base is being created for the first time, or if it is to be reinitialized, the $INT (Initialize) control card must precede all other control cards and member definitions.

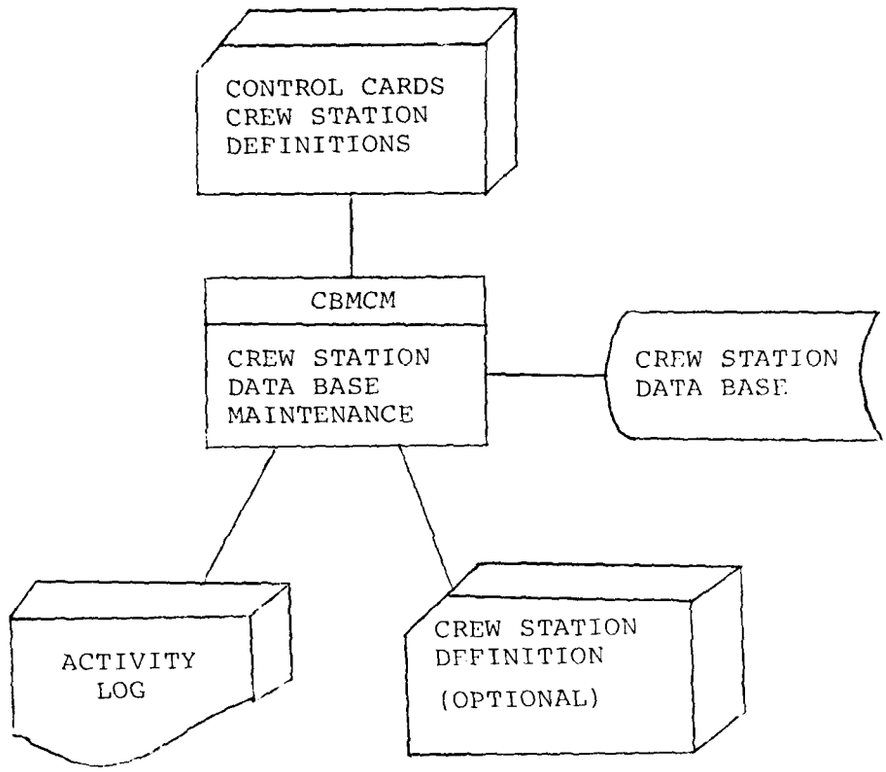


Figure 60. Data Flow for Program CBMCM.

5.2 RESTRICTIONS AND LIMITATIONS

A maximum of 20 members may be added to the Crew Station Data Base. The sum of the record counts for all the members may not exceed 1979 records. Information on the number of members on the Data Base and their size may be obtained by using the $PRT control card, omitting reference to any membername. Membernames are limited to 8 alphanumeric characters. A member definition may contain a maximum of 300 panels and 300 controls. Additional limitations are described in Paragraph 5.3.2, "Specifying Processing Desired."

5.3 HOW TO USE PROGRAM CBMCM

The example used to illustrate this program is based on the crew station in Figure 61 consisting of a seven-drawer desk. In modeling the desk, only the desk's top, front side, and leg are defined. The other sides are not needed because they do not cause any physical or visual interference to a man-model seated at a desk.

5.3.1 Specifying the Input Data

Using the dimensions of the desk, and the origin as indicated in the figure, three dimensional coordinates are obtained for the various vertices of the panels and for the locations of the controls. The program CBMCM is set up to accept crew station definitions in any three dimensional cartesian coordinate system. The coordinate system for COMBIMAN is a right handed system (positive x forward, positive y to the left, and positive z up). The user must supply the program CBMCM with the three-dimensional coordinates of the Seat Reference Point (SRP) with respect to the origin of the crew station's coordinate system. From these data, the program converts all input coordinates of the panels and controls to the coordinate system of the COMBIMAN.

Figure 62 shows an example of a typical Aircraft Coordinate system and its related COMBIMAN Coordinate system.

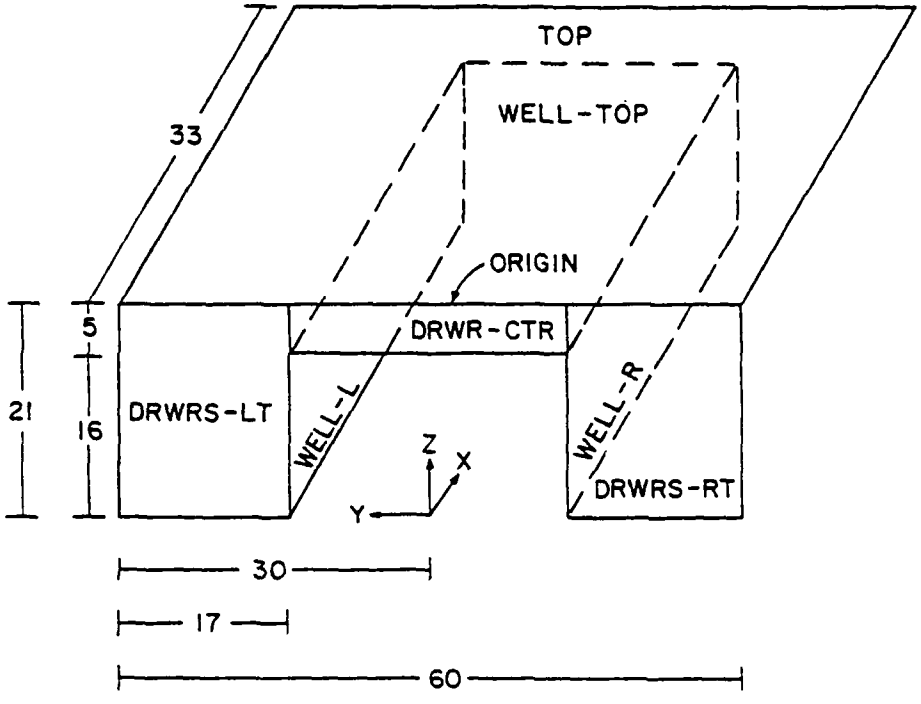


Figure 61. Sample Crew Station - DESK.

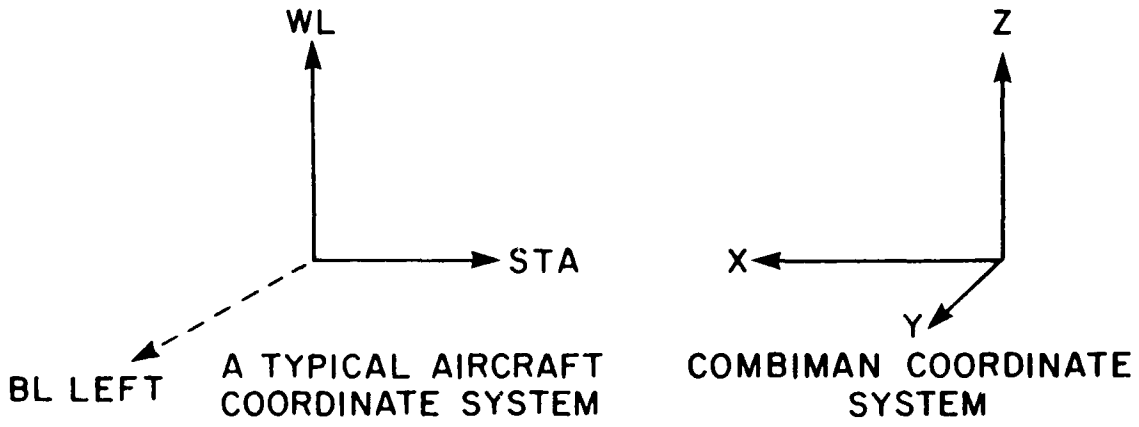


Figure 62. An Example of a Typical Aircraft Coordinate System and Its Related COMBIMAN Coordinate System.

Panels for the crew station must have three to six vertices. Vertices are entered into the program consecutively, going either clockwise or counterclockwise along the perimeter of the panel. Some examples of valid and invalid panels are shown in Figure 63. A total of seven panels make up the "DESK" in the example. Each panel has four vertices, and is rectangular in shape. The coordinates of the vertices are shown in Figure 64a and b. If a panel has more than 6 vertices, or has a curved edge so that more than 6 vertices are required to approximate the curve, the panel may be subdivided into multiple panels of 3-6 vertices.

Controls are defined by absolute or relative coordinates. If the control is not placed on a panel, it must be defined in absolute coordinates (the x, y, and z coordinates of the control are given relative to the origin of the crew station coordinate system). Before storing on the Data Base, the coordinates are translated and rotated to the COMBIMAN system of coordinates by CBMCM.

If the control is located on a defined panel, its coordinates can be given relative to a named vertex of the panel. In this instance, the x- and y-displacements are given relative to the vertex number specified. The z-value must be zero. The x-displacement is the offset from the vertex number n in the direction of the line connecting $vertex_n$ and $vertex_{n-1}$. The y-displacement is in direction of the line connecting $vertex_n$ and $vertex_{n+1}$. The convention for determining the location of a control in a panel relative to its vertices is shown in Figure 65.

5.3.2 Specifying Processing Desired

Program CBMCM allows the user to maintain the Data Base by the addition, deletion, listing, etc. of the crew station definitions. The function request formats are shown in Figure 66. These requests (one request per card) plus the crew station definitions are used as input to the program. The control cards may be input in any order with one exception. If the Data Base is to be initialized, the $INT control card must be the first input

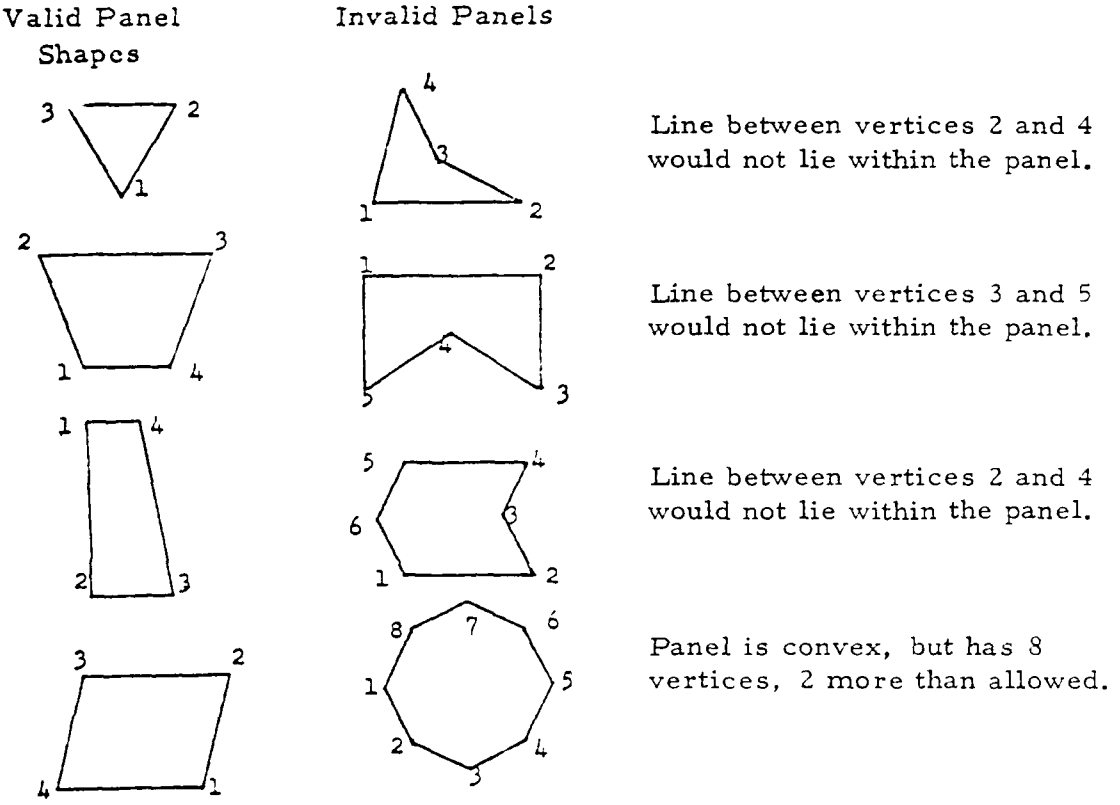
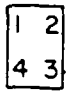


Figure 63. Example of Valid and Invalid Panels.

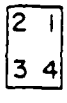
1 TOP

POINT	X	Y	Z
1	0.0	30.0	0.0
2	33.0	30.0	0.0
3	33.0	-30.0	0.0
4	0.0	-30.0	0.0



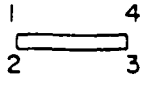
2 DRWRS - LT

POINT	X	Y	Z
1	0.0	30.0	0.0
2	0.0	13.0	0.0
3	0.0	13.0	-21.0
4	0.0	30.0	-21.0



3 DRWRS - RT

POINT	X	Y	Z
1	0.0	-30.0	0.0
2	0.0	-13.0	0.0
3	0.0	-13.0	-21.0
4	0.0	-30.0	-21.0



4 DRWRS - CT

POINT	X	Y	Z
1	0.0	13.0	0.0
2	0.0	13.0	-5.0
3	0.0	-13.0	-5.0
4	0.0	-13.0	0.0

Figure 64a. X, Y and Z Coordinates of Panels of DESK.

5WELL - LT

POINT	X	Y	Z
1	0.0	13.0	-5.0
2	0.0	13.0	-21.0
3	33.0	13.0	-21.0
4	33.0	13.0	-5.0

6WELL - RT

POINT	X	Y	Z
1	0.0	-13.0	-5.0
2	0.0	-13.0	-21.0
3	33.0	-13.0	-21.0
4	33.0	-13.0	-5.0

7WELL - TOP

POINT	X	Y	Z
1	0.0	13.0	-5.0
2	33.0	13.0	-5.0
3	33.0	-13.0	-5.0
4	0.0	-13.0	-5.0

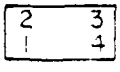


Figure 48. X, Y and Z Coordinates of Pan...

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UNCLASSIFIED UDR-TR-80-44 AFAMRL-TR-80-91 NL

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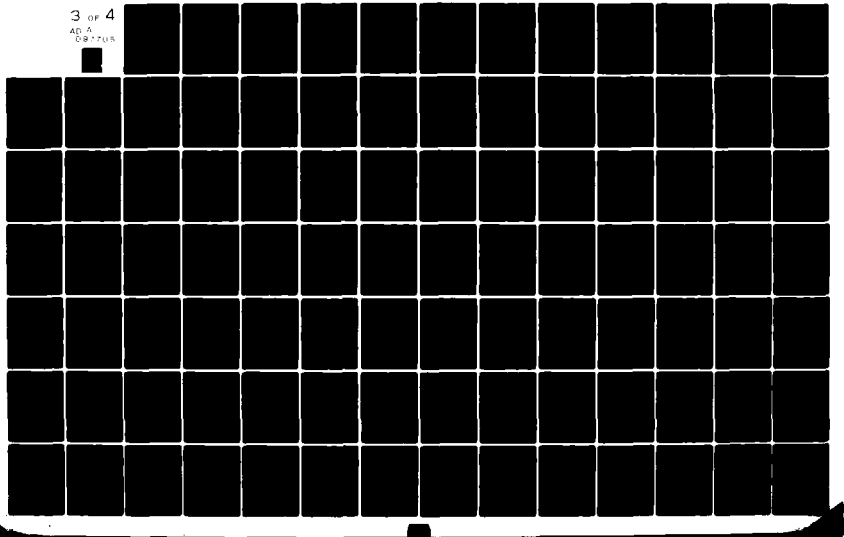


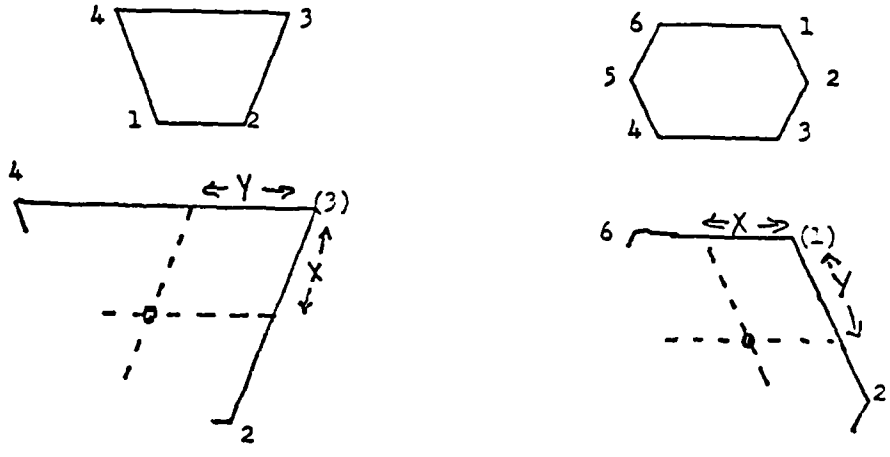


Figure 65. Convention for Determining the Location of a Control in a Panel Relative to Its Vertices.

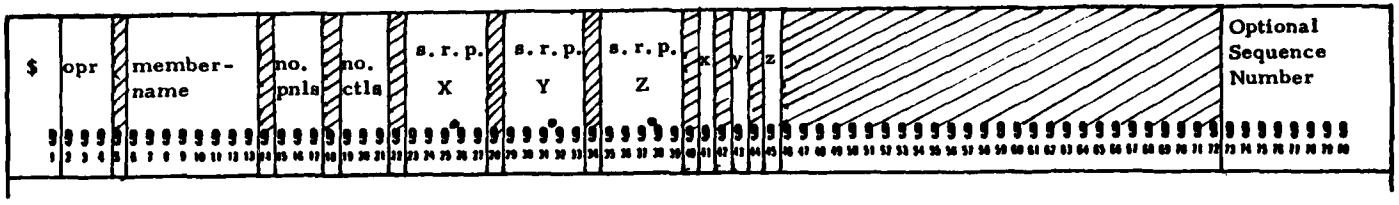


Figure 66. Program CBMCM Control Card Format.

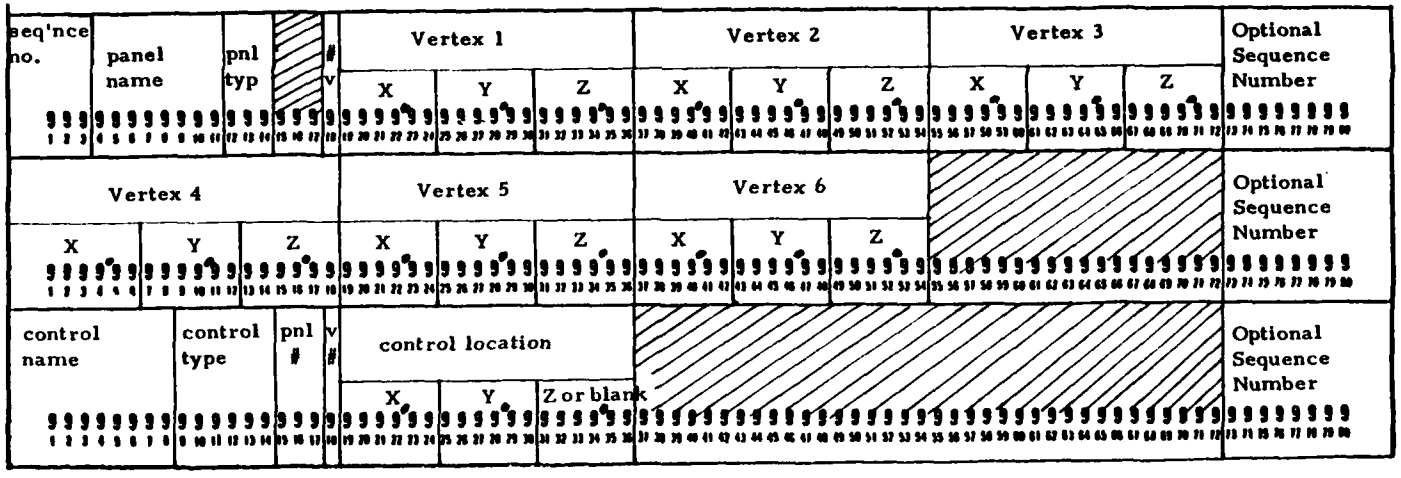


Figure 67. (a) Program CBMCM ADD Member Card Format for Panels
(b) Program CBMCM ADD Member Card Format for Panels (Continued).
(c) Program CBMCM ADD Member Card Format for Controls.

card. The control card formats are described in the following paragraphs.

5.3.2.1 ADD CREW STATION MEMBER Function

$ADD membername npnls nctls srpx srpy srpz x y z (followed by a crew station definition).

The ADD CREW STATION MEMBER function adds the specified data under the name membername to the Crew Station Data Base. The membername is limited to a maximum length of eight characters. The crew station definition contains npnls panels, and nctls controls. These numbers should be entered as an integer, right justified in its three digit field. The Seat Reference Point (SRP) coordinates are srpx, srpy, and srpz and are entered as real numbers in five digit fields. If a decimal point is omitted, the program CBMCM will place one between the second and third digits from the right. The directions of the positive x, y, and z coordinate axes are indicated by the characters in the x, y, and z fields respectively. The possible values for x, y, and z are F for forward, A for aft, L for left, R for right, U for up, and D for down. These directions are given with respect to the seated crewmember. If the crew station represents a seat, the last four letters of its membername should be "SEAT".

For each crew station panel there are two format data cards, shown in Figure 67a and 67b. In Figure 67a, columns 1-3 contain an integer sequence number of the panel, right justified in the field. The first panel entered should have a sequence number of one. Panel numbers need not be consecutive, but they must be unique. Columns 4-11 contain the eight-character name of the panel. Columns 15-17 contain the panel type, as an integer, right justified. ("0" or "1" - general crew station panel, "2" - seat panel, and "3" - rudder/brake pedal panel). If no type code is specified, "1" is assumed. Column 18 contains the count of the number of vertices of the panel. The panel must have 3 to 6 vertices. The x, y and z coordinates of each vertex are entered consecutively, going either clockwise or counterclockwise

```
$ADD DESK          7   8 -15.0    0.0 -11.0 F L U
  1TOP            04    0.0   30.0    0.0   33.0   30.0    0.0   33.0  -30.0    0.0
   0.0  -30.0    0.0
  2DRWRS-LT       04    0.0   30.0    0.0    0.0   13.0    0.0    0.0   13.0  -21.0
   0.0   30.0  -21.0
  3DRWRS-RT       04    0.0  -30.0    0.0    0.0  -13.0    0.0    0.0  -13.0  -21.0
   0.0  -30.0  -21.0
  4DRWRS-CT       04    0.0   13.0    0.0    0.0   13.0   -5.0    0.0  -13.0   -5.0
   0.0  -13.0    0.0
  5WELL-LT        04    0.0   13.0   -5.0    0.0   13.0  -21.0   33.0   13.0  -21.0
  33.0   13.0   -5.0
  6WELL-RT        04    0.0  -13.0   -5.0    0.0  -13.0  -21.0   33.0  -13.0  -21.0
  33.0  -13.0   -5.0
  7WELL-TOP       04    0.0   13.0   -5.0   33.0   13.0   -5.0   33.0  -13.0   -5.0
   0.0  -13.0   -5.0
L-F-CRNR     0  12    0.0    0.0
L-S-CRNR     0  11    0.0    0.0
R-F-CRNR     0  13    0.0    0.0
R-S-CRNR     0  14    0.0    0.0
DRWRCTNR     0  42    0.0  -13.0
DRWRLB       0  00   -1.0   22.0  -19.0
DRWRLC       0  00   -1.0   22.0  -13.0
DRWRLT       0  00   -1.0   22.0   -7.0
```

(1)

(2)

(3)

Figure 68. Sample Data for $ADD Member Function.

around the perimeter of the panel. All the panel definitions are listed together.

Each control is defined on a card using the format in Figure 67c. The control name is listed in columns 1-8. If the control is to be defined relative to a vertex, pnl# references a panel defined previously. The entry is an integer value, right justified in the field. The vertex to which the control is relative to is specified in the one-digit field v#. If a value is entered for pnl#, the field v# must be non-zero. The coordinates of the control are real numbers. If the location is relative to a defined panel, the z-field is blank. If the location is absolute, all three values (x, y, and z) must be supplied. If no decimal point is supplied, the program places one between the second and third right-most digits.

An example of the input definition for the member "DESK" is shown in Figure 68. The first outlined area is the $ADD control card. The second outlined area shows the panel definition cards followed by the control definition cards.

Should an error be detected by the program in the input data for a member, the member is not added.

5.3.2.2 CHECK CREW STATION MEMBER Function

$CHK membername npnls nctls srpx srpy srpz x y z (followed by a workspace definition).

The CHECK CREW STATION MEMBER function operates in the same way the ADD CREW STATION MEMBER function does, EXCEPT that the member is not added. This function checks new member input data for proper format and content.

5.3.2.3 DELETE CREW STATION MEMBER Function

$DEL membername

The DELETE CREW STATION MEMBER function removes the specified crew station member from the Data Base, but does NOT make the space the member occupied available for reuse. In order to make the space available the COMPRESS CREW STATION DATA BASE function must be used.

5.3.2.4 COMPRESS CREW STATION DATA BASE Function $CMP

The COMPRESS CREW STATION DATA BASE function compresses used space together maximizing the amount of continuous unused space. The intermediate blocks of unused space are created by the DELETE CREW STATION MEMBER function. When the message "CBM127A NO SPACE, CANNOT ADD membername" appear, it is necessary to use this function. If the compress function, followed by the $ADD function gives the CBM127A message, the Data Base is full.

5.3.2.5 DUMP CREW STATION MEMBER Function

$DMP membername
$DMP

The DUMP CREW STATION MEMBER function prints the contents of the crew station member membername, or the complete Crew Station Data Base if no member name is given on the control card. The format of the display, per second is:

RECORD nn +=+ (record in EBCDIC) +=+
+=+ (record in hexadecimal) +=+
+=+ (rest of record in hexadecimal) +=+

The +=+ characters act as delimeters of the displayed data. This function is used primarily by system programmers to test the file.

5.3.2.6 END PROGRAM Function

$END

The END PROGRAM function terminates execution of the program CBMCM.

5.3.2.7 INITIALIZE CREW STATION DATA BASE Function

$INT

The INITIALIZE CREW STATION DATA BASE function resets the Data Base to an original unused state. The primary purpose of this function is to establish a Crew Station Data Base.

5.3.2.8 PUNCH CREW STATION MEMBER Function

$PCH membername

The PUNCH CREW STATION MEMBER function punches a copy of the specified member in a format that the ADD CREW STATION MEMBER function requires. Specifying a membername that does not exist causes a printout of all the membernames on the Data Base. This function does not remove any member from the Data Base.

5.3.2.9 PRINT CREW STATION MEMBER Function

$PRT membername
$PRT

The PRINT CREW STATION MEMBER function prints the contents of the specified member, membername in a format similar to that of the ADD CREW STATION MEMBER function. Specifying no name, or a nonexisting name causes a printout of the index containing member names and their record numbers, on the Data Base, and their origin and orientation.

5.3.3 Submitting a Processing Request

The sequence of JOB CONTROL LANGUAGE (JCL) cards needed to execute the program CBMCM are shown in Figure 69. All function control cards and member definition cards follow the "//SYSIN DD*" card. The "//FT01F001" card included in this sequence assumes that the space for the Data Base has already been allocated on disk. If this condition is not met, the "//FT01F001" card specified in Figure 69 should be replaced by the sequence of cards shown in Figure 70. The first function control card in this case should be the $INT card, which initializes the Data Base. This sequence to allocate space for the Data Base and to initialize it should be executed only once. Thereafter, the simplified "//FT01F001" card shown in Figure 69 should be used for all file manipulations.

The last function control card read into the program should be the "$END" card.

```
//CB4CM    JOB MESS                                                  00001000
//JOBLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR                          00001100
//CB4CM    EXEC PGM=CBMCM                                            00001200
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,DISP=SHR                         00001300
//FT05F001 DD DDNAME=SYSIN                                           00001400
//FT06F001 DD SYSOUT=A                                               00001500
//FT07F001 DD SYSOUT=B                                               00001600
//SYSUDUMP DD SYSOUT=A                                               00001700
//SYSIN    DD *                                                      00001800


          CBMCM FUNCTION CONTROL CARDS AND
             MEMBER DEFINITION DATA


/*
//                                                                   00001900
```

Figure 69. Job Control Cards to Execute Program CBMCM.

```
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,UNIT=DISK,DISP=(NEW,CATLG),      00001300
//            VOL=SER=DISK01,SPACE=(368,2000),                       00001310
//            DCB=(BLKSIZE=368,LRECL=368,RECFM=FB)                   00001320
```

Figure 70. FT01 DD Card to Allocate Space on Disk and Execute Program CBMCM.

5.3.4 Interpreting the Output

The program CBMCM generates output to the card punch, disk file, or printer, depending on the specified control card function. The formats for the printed output will be discussed in this section. Punched records have the same format as the input data records discussed in Paragraph 5.3.2. The physical format of the records on the Data Base is not described here.

Five basic formats are used by CBMCM for printed output. These format types, their use, and their examples are presented in this subsection. All types begin with the same heading "CBMCM", the data and time of the program execution, and a page number.

The first type of output is generated by the INITIALIZE, PUNCH, COMPRESS, DELETE, and END functions. The output indicates the start and end of processing associated with the specified function. For the COMPRESS function, additional messages are supplied, indicating that a particular member was, or was not, moved in the process of combining unused space. An example of this format, for the COMPRESS function, is shown in Figure 71.

The second type of output is generated by the PRINT or PUNCH functions when the $PRT or $PCH control card is supplied with blank membername field. This causes a listing of the index of the Data Base in the following format:

nn.) membername, EXTENT = (n1, n2), np PANELS, nc CONTROLS,
ORIGIN = (xx, yy, zz), ORIENT = (a, b, c)

where:

nn	is the number of the member identification record within the directory
membername	is the name of the member identified
n1	is the location of the first record which defines this member
n2	is the location of the last record which defines this member

```
CBM100I $CMP
CBM128I HAC1       WAS IN PLACE.
CBM128I AZL        WAS IN PLACE.
CBM128I AZ         WAS IN PLACE.
CBM128I FWC1       WAS IN PLACE.
CBM128I AZ-01      WAS IN PLACE.
CBM128I AZE-01     WAS IN PLACE.
CBM129I BI-CHAIR NOW IN PLACE.
CBM129I BI-NAV01 NOW IN PLACE.
CBM129I BI-NAV1A NOW IN PLACE.
CBM129I BI-NAV2A NOW IN PLACE.
CBM129I SALR       NOW IN PLACE.
CBM129I SALL       NOW IN PLACE.
CBM129I DESK       NOW IN PLACE.
CBM138I COMPRESS FINISHED.
```


Figure 71. A Sample Output of the $CMP Function.

np	is the number of panels associated with this member
nc	is the number of controls associated with this member
xx, yy, zz	is the location of the seat reference point with respect to the origin of the system of coordinates of the crew station
a	is the orientation of the positive x-axis of the crew station
b	is the orientation of the positive y-axis of the crew station
c	is the orientation of the positive z-axis of the crew station

This information was originally supplied to the data base on the $ADD control card. An example of the PRINT function is shown in Figure 72.

The third type of output is generated by the DUMP function. This function should be used primarily by systems programmmers to locate the cause of I/O (Input/Output) errors on the Data Base. For the member specified on the $DMP control card, a message giving directory or index information is printed using the second output format described. Each data record associated with the member is printed in the following format:

```
RECORD nn +=+ (record in EBCDIC)  +=+
+=+ (record in hexadecimal)  +=+
+=+ (remainder of record in hexadecimal)  +=+
```

where nn is the location of the record within the Data Base. The record in EBCDIC is printed using a 25A4 format. The record in hexadecimal is printed using a 10Z8 format. An example of the Dump function is shown in Figure 73.

The fourth output format is used by the CHECK and ADD functions. After reading the control card and checking it for errors, the information contained on the card is reformatted and written out to the printer. Error messages pertaining to data contained on the card are printed before this message.

```
CBM1001 $PRT
    9.) SACR     , EXTENT=(    782,    805),   23 PANELS,    1 CONTROLS, ORIGIN=( -27.00,   59.25,  -15.75), ORIENT.=(F,R,U).
   10.) SACL     , EXTENT=(    806,    829),   23 PANELS,    1 CONTROLS, ORIGIN=( -27.00,   19.25,  -15.75), ORIENT.=(F,R,U).
   11.) B1-NAV2A, EXTENT=(    754,    781),   27 PANELS,    1 CONTROLS, ORIGIN=(  22.00,  396.61,   62.50), ORIENT.=(R,A,U).
   12.) B1-CHAIR, EXTENT=(    689,    693),    4 PANELS,    1 CONTROLS, ORIGIN=(   0.0 ,    0.0 ,    0.0 ), ORIENT.=(A,R,U).
   13.) B1-NAV1A, EXTENT=(    724,    753),   29 PANELS,    1 CONTROLS, ORIGIN=(  22.00,  396.61,   62.50), ORIENT.=(R,A,U).
   14.) B1-NAV01, EXTENT=(    694,    723),   29 PANELS,    1 CONTROLS, ORIGIN=(  22.00,  396.61,   62.50), ORIENT.=(R,A,U).
   15.) A7E-01   , EXTENT=(    592,    688),   51 PANELS,   46 CONTROLS, ORIGIN=(  22.00,  396.61,   62.50), ORIENT.=(R,A,U).
   16.) A7-01    , EXTENT=(    489,    591),   57 PANELS,   46 CONTROLS, ORIGIN=(   0.0 ,    0.0 ,    0.0 ), ORIENT.=(F,L,U).
   17.) A7       , EXTENT=(    358,    460),   57 PANELS,   46 CONTROLS, ORIGIN=(   0.0 ,   -5.60,   -4.25), ORIENT.=(R,F,U).
   18.) FWCI     , EXTENT=(    461,    488),   27 PANELS,    1 CONTROLS, ORIGIN=(   0.0 ,    0.0 ,    0.0 ), ORIENT.=(R,F,U).
   19.) A7E      , EXTENT=(     45,    357),  204 PANELS,  109 CONTROLS, ORIGIN=(   0.0 ,  103.40,  265.00), ORIENT.=(F,L,U).
   20.) HACI     , EXTENT=(     22,     44),   18 PANELS,    5 CONTROLS, ORIGIN=(  16.00,    0.0 ,   18.00), ORIENT.=(R,U,A).
   21.) DESK     , EXTENT=(    830,    844),    7 PANELS,    8 CONTROLS, ORIGIN=( -15.00,    0.0 ,  -11.00), ORIENT.=(F,L,U).
```

Figure 72. A Sample Output of the $PRT (No Membername) Function.

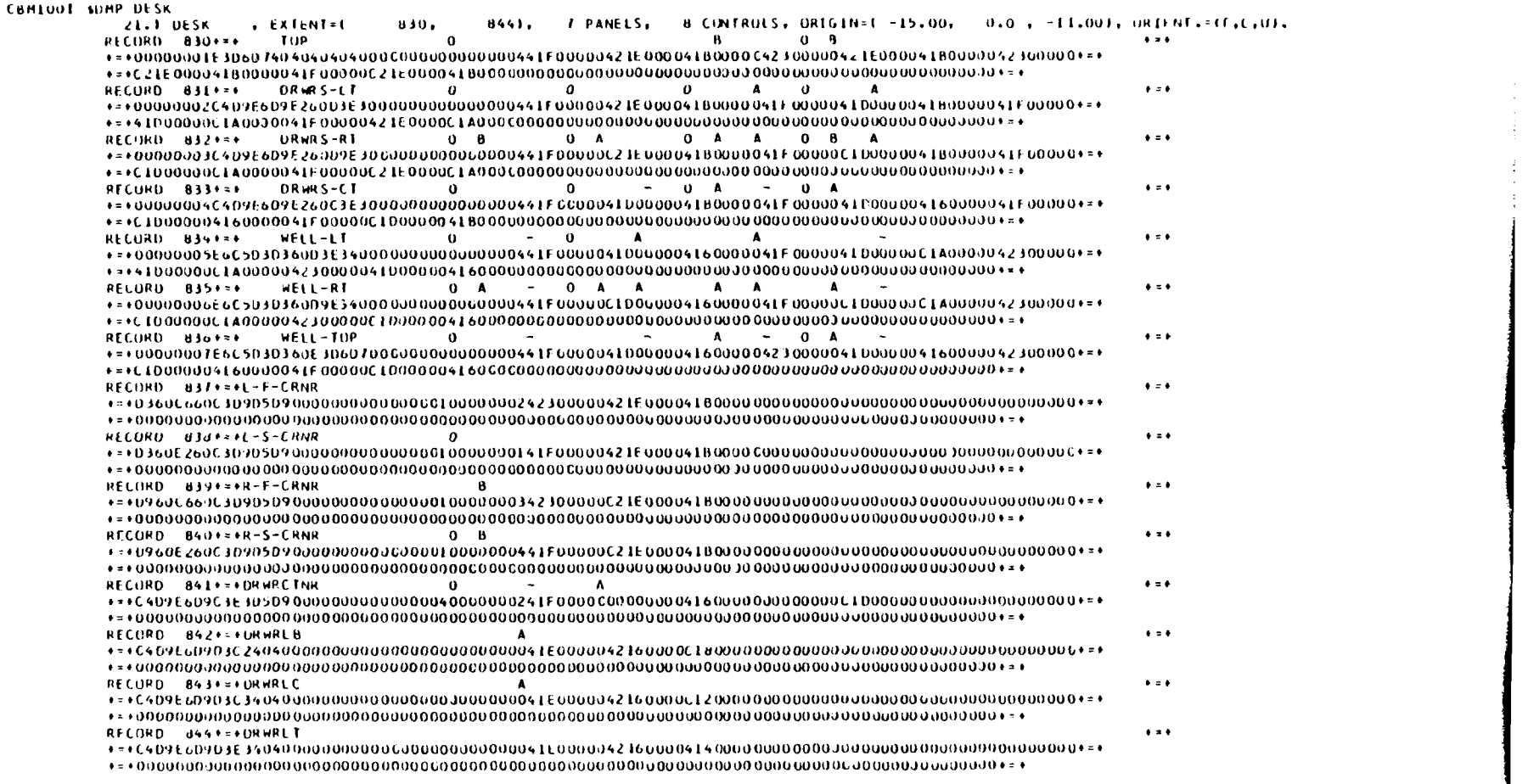


Figure 73. A Sample Output of the $DMP Function.

Panel definition card, after being read and checked for errors is printed. The format used for printing the panel definition cards is as follows:

nn.) pnl nm, TYPE=tt, nv VERTICES -- INPUT COORD -- -- ABSOLUTE COORD -

(xx_1, yy_1, zz_1) (ax_1, ay_1, az_1)

$\vdots$

$(xx_{nv}, yy_{nv}, zz_{nv})$ $(ax_{nv}, ay_{nv}, az_{nv})$

where:

nn	is the panel number
pnl nm	is the panel name
tt	is the panel type
nv	is the number of vertices used to define the panel
xx_i, yy_i, zz_i	are the x, y, and z coordinates for the i^{th} vertex of the panel, in the crew station system of coordinates, where i = 1, nv.
ax_i, ay_i, az_i	are the x, y, and z coordinates of the i^{th} vertex of the panel, converted to the COMBIMAN system of coordinates, where i = 1, nv.

After the panel definition data, the control data are printed, using the following format:

cntl nm tt pnl ref. v.# (xx,yy,zz) TO (ax,ay,az) & (rx,ry)

where:

cntl nm	is the 8 character name of the control
tt	is the 2 digit control type
pnl ref	is the panel where the control is located (if applicable)
v.#	is the reference vertex number for that control (if applicable)
xx, yy, zz	are the three dimensional coordinates (relative or absolute) which define the location of the control

ax, ay, az } are the three dimensional absolute coordinates which define the location of the control in the COMBIMAN system of coordinates

rx, ry } are the two dimensional relative coordinates of the control. If the control was not defined relative to a panel, rx=ry=0.0.

An example of this fourth format, for the $ADD control card, is shown in Figure 74.

The fifth and last format is similar to that used for the ADD function, and is for the PRINT function when a valid membername is specified. The main difference between this format and the fourth is that this format does not print the original input data which were provided when the member was added to the Data Base. After the index record for the member is printed, the panel definition data are output in the following format:

nn.) pnl nm, TYPE=tt, nv VERTICES--ABSOLUTE COORDINATES--
(xx_1, yy_1, zz_1)
:
(xx_{nv}, yy_{nv}, zz_{nv})

where:

nn — is the panel number

pnl nm — is the 8-character name of the panel

tt — is the panel type

nv — is the number of vertices which define the panel

xx_i, yy_i, zz_i } are the x, y, and z coordinates of the i^{th} vertex of the panel, in the COMBIMAN system of coordinates, where i = 1, nv.

After the panel definition data, the control data are printed, using the following format:

cntl nm tt pnl ref v# (ax, ay, az) (rx, ry)

where:

cntl nm — is the 8-character name of the control

tt — is the 2-digit control type

```
CBM1001 $PRT DESK
          21.) DESK     , EXTENT=(     830,     844),   7 PANELS,   8 CONTROLS, ORIGIN=( -15.00,   0.0 , -11.00), ORIENT.=(F,L,U).
           1.) TOP      , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00   30.00   11.00)
                                              (  48.00   30.00   11.00)
                                              (  48.00  -30.00   11.00)
                                              (  15.00  -30.00   11.00)
           2.) DRWRS-LT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00   30.00   11.00)
                                              (  15.00   13.00   11.00)
                                              (  15.00   13.00  -10.00)
                                              (  15.00   30.00  -10.00)
           3.) DRWRS-RT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00  -30.00   11.00)
                                              (  15.00  -13.00   11.00)
                                              (  15.00  -13.00  -10.00)
                                              (  15.00  -30.00  -10.00)
           4.) DRWRS-CT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00   13.00   11.00)
                                              (  15.00   13.00    6.00)
                                              (  15.00  -13.00    6.00)
                                              (  15.00  -13.00   11.00)
           5.) WELL-LT , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00   13.00    6.00)
                                              (  15.00   13.00  -10.00)
                                              (  48.00   13.00  -10.00)
                                              (  48.00   13.00    6.00)
           6.) WELL-RT , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00  -13.00    6.00)
                                              (  15.00  -13.00  -10.00)
                                              (  48.00  -13.00  -10.00)
                                              (  48.00  -13.00    6.00)
           7.) WELL-TOP, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                              (  15.00   13.00    6.00)
                                              (  48.00   13.00    6.00)
                                              (  48.00  -13.00    6.00)
                                              (  15.00  -13.00    6.00)

CONTROL- TYPE IN-PANEL POINT --ABSOLUTE COORDINATES-  RELATIVE-COORDINATE
-------- ---- -------- ----- ----------------------  --------------------
L-F-CRNR    0 TOP        2   (  48.00   30.00   11.00)  (   0.0     0.0 )
L-S-CRNR    0 TOP        1   (  15.00   30.00   11.00)  (   0.0     0.0 )
R-F-CRNR    0 TOP        3   (  48.00  -30.00   11.00)  (   0.0     0.0 )
R-S-CRNR    0 TOP        4   (  15.00  -30.00   11.00)  (   0.0     0.0 )
DRWRCTNR    0 DRWRS-CT   2   (  15.00    0.0     6.00)  (   0.0   -13.00)
DRWRLB      0            0   (  14.00   22.00   -8.00)  (   0.0     0.0 )
DRWRLC      0            0   (  14.00   22.00   -2.00)  (   0.0     0.0 )
DRWRLT      0            0   (  14.00   22.00    4.00)  (   0.0     0.0 )
```

Figure 74. A Sample Output the $ADD Function.

pnl ref — is the panel the control is located within (if applicable)

v# — is the reference vertex number for that control (if applicable)

ax, ay, az — are the three dimensional coordinates which define the control in the COMBIMAN system of coordinates

rx, ry — are the two dimensional relative coordinates of the control. If the control was not defined relative to a panel, rx=ry=0.0.

An example of the fifth format is shown in Figure 75.

5.4 PROGRAM MESSAGES - INCLUDING ERROR CORRECTION

The program CBMCM prints out both information and action related messages. The message format is as follows:

CBMlnni message text

where

nn — is the message number

i — indicates the action code (I=informational, A=action to be performed), and

message text — is the text of the message.

Unless otherwise noted, all messages are generated by the routine CBMCM.

The messages in effect are as follows:

CBM100I control card image
Reason: User has submitted a control card.
System Action: None.
User Action: None.

CBM101A operation UNKNOWN OPERATION.
Reason: The operation on the control card (shown in the previous CBM100I message) is unknown.
System Action: This control card is ignored.
User Action: Correct the card and resubmit.

```
CBM100I $ADD DESK        F   8-15.00  0.0 -11.00 F L U
CBM119I MEMBER, DESK     , HAS    7 PANELS AND    8 CONTROLS.
CBM120I COORDINATES ARE TRANSLATED TO ( -15.00,    0.0 , -11.00).
CBM121I COORDINATES GIVEN AS F, L AND U ARE NOW F, L, AND U.
          1.) TOP      , TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                              (   0.0    30.00    0.0 ) TO (   15.00   30.00   11.00)
                                              (  33.00   30.00    0.0 ) TO (   48.00   30.00   11.00)
                                              (  33.00  -30.00    0.0 ) TO (   48.00  -30.00   11.00)
                                              (   0.0   -30.00    0.0 ) TO (   15.00  -30.00   11.00)
          2.) DRWRS-LT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                              (   0.0    30.00    0.0 ) TO (   15.00   30.00   11.00)
                                              (   0.0    13.00    0.0 ) TO (   15.00   13.00   11.00)
                                              (   0.0    13.00  -21.00) TO (   15.00   13.00  -10.00)
                                              (   0.0    30.00  -21.00) TO (   15.00   30.00  -10.00)
          3.) DRWRS-RT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                              (   0.0   -30.00    0.0 ) TO (   15.00  -30.00   11.00)
                                              (   0.0   -13.00    0.0 ) TO (   15.00  -13.00   11.00)
                                              (   0.0   -13.00  -21.00) TO (   15.00  -13.00  -10.00)
                                              (   0.0   -30.00  -21.00) TO (   15.00  -30.00  -10.00)
          4.) DRWRS-CT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                              (   0.0    13.00    0.0 ) TO (   15.00   13.00   11.00)
                                              (   0.0    13.00   -5.00) TO (   15.00   13.00    6.00)
                                              (   0.0   -13.00   -5.00) TO (   15.00  -13.00    6.00)
                                              (   0.0   -13.00    0.0 ) TO (   15.00  -13.00   11.00)
          5.) WELL-LT , TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                              (   0.0    13.00   -5.00) TO (   15.00   13.00    6.00)
                                              (   0.0    13.00  -21.00) TO (   15.00   13.00  -10.00)
                                              (  33.00   13.00  -21.00) TO (   48.00   13.00  -10.00)
                                              (  33.00   13.00   -5.00) TO (   48.00   13.00    6.00)
          6.) WELL-RT , TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                              (   0.0   -13.00   -5.00) TO (   15.00  -13.00    6.00)
                                              (   0.0   -13.00  -21.00) TO (   15.00  -13.00  -10.00)
                                              (  33.00  -13.00  -21.00) TO (   48.00  -13.00  -10.00)
                                              (  33.00  -13.00   -5.00) TO (   48.00  -13.00    6.00)
          7.) WELL-TOP, TYPE= 0, 4 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                              (   0.0    13.00   -5.00) TO (   15.00   13.00    6.00)
                                              (  33.00   13.00   -5.00) TO (   48.00   13.00    6.00)
                                              (  33.00  -13.00   -5.00) TO (   48.00  -13.00    6.00)
                                              (   0.0   -13.00   -5.00) TO (   15.00  -13.00    6.00)

    CONTROL - TYPE IN PANEL  POINT ---INPUT COORDINATES---      --ABSOLUTE COORDINATES-  RELATIVE-COORDINATES
    ------- ---- --------- ------ ------------------------      ----------------------  --------------------
    L-F-CRNR    0 TOP         2   (   0.0     0.0     0.0 ) TO (  48.00   30.00  11.00) & (   0.0     0.0 )
    L-S-CRNR    0 TOP         1   (   0.0     0.0     0.0 ) TO (  15.00   30.00  11.00) & (   0.0     0.0 )
    R-F-CRNR    0 TOP         3   (   0.0     0.0     0.0 ) TO (  48.00  -30.00  11.00) & (   0.0     0.0 )
    R-S-CRNR    0 TOP         4   (   0.0     0.0     0.0 ) TO (  15.00  -30.00  11.00) & (   0.0     0.0 )
    DRWRCTNR    0 DRWRS-CT    2   (   0.0   -13.00    0.0 ) TO (  15.00    0.0    6.00) & (   0.0   -13.00)
    DRWRLB      0             0   (  -1.00   22.00  -19.00) TO (  14.00   22.00   -9.00) & (   0.0     0.0 )
    DRWRLC      0             0   (  -1.00   22.00  -13.00) TO (  14.00   22.00   -2.00) & (   0.0     0.0 )
    DRWRLT      0             0   (  -1.00   22.00   -7.00) TO (  14.00   22.00    4.00) & (   0.0     0.0 )
CBM140I DESK      WITH    7 PANELS AND    8 CONTROLS HAS BEEN ADDED.
```

Figure 75. Example of Program CBMWM $PRT (Membername) Function Output Format.

CBM102A panelnumber INVALID PANEL NUMBER FOR POINT controlname.
Reason: The panel number which the control definition card specifies does not exist.
System Action: The control is assumed to be defined in absolute coordinates.
User Action: Delete the crew station member, correct the card, and resubmit.

CBM103A vertexnumber INVALID VERTEX NUMBER FOR POINT controlname.
Reason: The panel in which the control is to be defined does not have vertex vertexnumber.
System Action: Vertex number 1 is used.
User Action: Delete the crew station member, correct the error and resubmit the job.

CBM104A Z NOT ZERO, PANEL & VERTEX NOW ZERO FOR POINT controlname.
Reason: A panel number and a vertex number were specified, but the Z value was not zero.
System Action: Z is made zero and processing continues.
User Action: If setting Z equal to zero corrects the problem, no action needed. Otherwise, delete the crew station member, correct the card and resubmit.

CBM105A NO NAME GIVEN, operation IGNORED.
Reason: This operation requires a crew station member name, but none was supplied.
System Action: The operation is ignored.
User Action: Supply the member name and resubmit.

CBM106A membername NOT FOUND.
Reason: For the Delete, Dump, Punch or Print functions, the crew station member name given does not exist.
System Action: The directory of the Crew Station Data Base is printed.
User Action: Correct the error and resubmit.

CBM107A NUMBER OF PANELS/CONTROLS INVALID FOR MEMBER membername.
Reason: The number of panels or controls as specified on the Add function control card ($ADD) is either less than 1 or greater than 300.
System Action: The control card is ignored.
User Action: If the number as specified is less than 1, correct and resubmit. If the number as specified is greater than 300, split the workspace definition in two units and add separately.

CBM109A axis FOR Y INVALID, MEMBER IS membername.
Reason: During the Add function ($ADD), the direction of the user's Y-axis is not F, A, L, R, U or D.
System Action: The control card is ignored.
User Action: Correct the control card, and resubmit.

CBM110A axis FOR Z INVALID, MEMBER IS membername.
Reason: During the Add function ($ADD), the direction of the user's Z-axis is not F, A, L, R, U or D.
System Action: The control card is ignored.
User Action: Correct the control card and resubmit.

CBM111A X&Y, X&Z OR Y&Z ARE COLINEAR FOR MEMBER membername.
Reason: The directions of two or more of the user's axes are the same (ex. X=L & Y=U & Z=U or X=L & Y=U & Z=D).
System Action: The control card is ignored.
User Action: Pick unique directions for the axes and resubmit.

CBM112A DIRECTORY IS FULL, CANNOT ADD membername.
Reason: No space is available in the Crew Station Data Base directory to add an entry for this member.
System Action: The control card is ignored.
User Action: Increase the directory space and resubmit.

CBM113A PANEL IS ZERO, BUT POINT IS NOT FOR membername.
Reason: In defining a control, either both the panel number and the point number must be zero (or blank), or non-zero.
System Action: The control definition is taken as absolute.
User Action: Correct and resubmit.

CBM114A membername ALREADY EXISTS.
Reason: User tried to add a crew station definition under a name that already exists on the Data Base.
System Action: The control card is ignored.
User Action: Use a new name, and resubmit.

CBM115A END OF DATA.
Reason: The end of file was found before the END Program control card ($END).
System Action: The program is ended.
User Action: Check to make sure that all the control cards were processed.

CBM116A I/O ERROR ON RECORD recordnumber (INDEX).
Reason: An I/O error occurred on the Crew Station Data Base.
System Action: Terminates the program.
User Action: Contact systems programmer.

CBM117A I/O ERROR ON RECORD recordnumber (DATA).
Reason: An I/O error occurred on the Crew Station Data Base.
System Action: Terminates the program.
User Action: Contact systems programmer.

CBM119A NEW MEMBER, membername, HAS nn PANELS AND nn CONTROLS.
Reason: The user added a crew station definition to the Data Base.
System Action: The addition is accepted.
User Action: None.

CBM120I COORDINATES ARE TRANSLATED TO seat reference point coordinate.
Reason: The user added a crew station definition to the Data Base.
System Action: The addition is accepted.
User Action: None.

CBM121I COORDINATES GIVEN AS axis, axis AND axis ARE NOW R, F, AND U.
Reason: The user added a crew station definition to the Data Base.
System Action: The addition is accepted.
User Action: None.

CBM122I PROGRAM END.
Reason: The End Program function control card ($END) or the end of the file card was encountered, or there was an I/O error.
System Action: The program ends.
User Action: Check to make sure that all control cards were accepted, and processed correctly.

CBM123I membername DELETED.
Reason: The user submitted a delete Crew Station Definition function control card ($DEL).
System Action: The requested deletion was made.
User Action: None.

CBM124I INITIALIZED.
Reason: The user requested that the Crew Station Data Base be initialized.
System Action: The data base is initialized.
User Action: None.

CBM125A PANEL NOT DEFINED FOR CONTROL controlname.
Reason: In defining a control, the user specified the control in a panel not found in this crew station.
System Action: The control is defined absolutely.
User Action: Make sure that the panel is defined. Correct and resubmit.

CBM126I membername PUNCHED.
Reason: The user requested that member membername be punched on cards.
System Action: Punching is completed.
User Action: None.

CBM127A NO SPACE, CANNOT ADD membername.
Reason: There is not enough space in the data base to hold the requested addition.
System Action: The control card is ignored.
User Action: Increase the space for the Crew Station Data Base.

CBM128I membername WAS IN PLACE.
Reason: The user requested that the Data Base be compressed. The member, membername was already compressed, and not moved.
System Action: The named member was not moved.
User Action: None.

CBM129I membername NOW IN PLACE.
Reason: The user requested that the data base be compressed. The member, membername was not in place, and therefore has been compressed.
System Action: The member is compressed.
User Action: None.

CBM130A panelname USED IN PANELS $panelnumber_1$ AND $panelnumber_2$.
Reason: In defining a crew station member, two panels have the same name. The number of these panels are $panelnumber_1$ and $panelnumber_2$.
System Action: Both panels are accepted in spite of the duplicate names.
User Action: Delete the definition, change one of the names, and resubmit.

CBM131A panelname HAS SAME PANEL NUMBER AS panelnumber.
Reason: In adding a crew station definition, two panels have the same panel number.
System Action: Both panels are accepted. Note that references to the second will cause a reference to the first.
User Action: Delete the crew station definition, correct the error, and resubmit.

CBM132A controlname IS A DUPLICATE NAME.
Reason: In adding a crew station definition, two controls have the same name.
System Action: Only the first control can be referenced.
User Action: Delete the definition, change one of the names to make it unique, and resubmit.

SECTION 6
VISIBILITY DATA BASE MAINTENANCE PROGRAM (CBMVM)

One of the important functions provided by the interactive program CBM04 is the VISIBILITY PLOT function. This function evaluates the visual man-model crew station interaction. It uses the eye location of the current man-model and the three dimensional coordinates of selected crew stations, stored on the Visibility Data Base, to generate on-line plots of the man-model's Visibility Data Base on disk and to make visibility crew station members available to the user. Note that the Visibility Data Base may contain the same geometric panels as the Crew Station Data Base, a subset of the crew station data base, or an entirely different set of panels and contours. A data flow of the program CBMVM is shown in Figure 76.

6.1 PROCESSING PERFORMED

The program CBMVM allows the user to create and maintain the Visibility Data Base. Input data are supplied on 80-character computer cards or card images on magnetic tape and are processed according to the user's selection of control commands. These commands allow the user to add or delete members, print information about existing members, or list contents of the Data Base. It can also be used to compress the members within the Data Base to maintain continuous blocks of available disk space.

The control cards may be input in any order with one exception. If the Data Base is created for the first time or is re-initialized, the $INT (initialize) control card must precede all other control cards and member definitions.

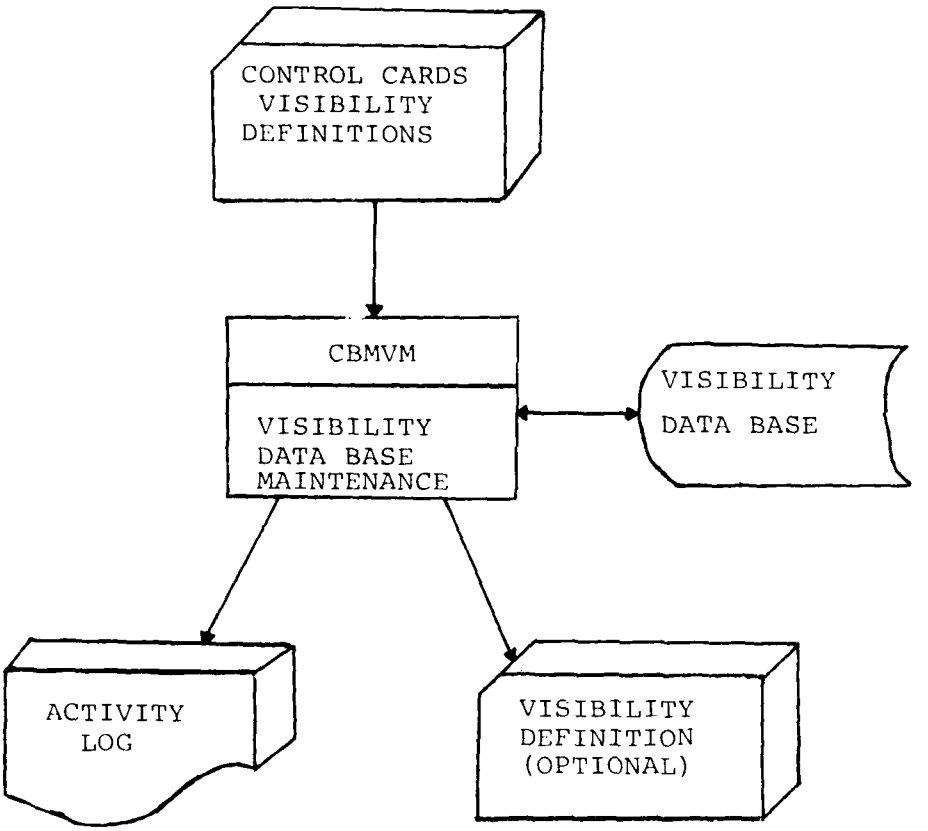


Figure 76. Data Flow for Program CBMVM.

6.2 RESTRICTIONS AND LIMITATIONS

A maximum of 20 members of crew stations may be added to the Visibility Data Base. Each member may contain up to 15 panels or contours. The panels and contours may consist of two to 100 vertices. The large number of vertices per panel allows a greater accuracy of approximating curved edges than is possible with the Crew Station Data Base. These vertices must be input in consecutive order, as described in Paragraph 6.3.1.

The total number of available records on the Visibility Data Base for member coordinate information is 1479.

Other limitations will be described in Paragraph 6.3.2, "Specifying Processing Desired".

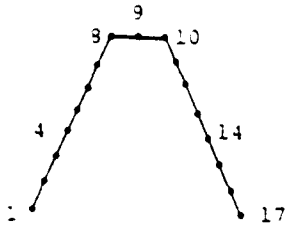
6.3 HOW TO USE CBMVM

The example used to illustrate this program is based on the A7E-01 crew station shown with the seated man-model in Figure 4. The panels and edges of the A7E-01 crew station were combined to produce a visibility member consisting of three panels: the upper and lower window panels and the cockpit canopy panels. These panels are shown in Figure 77, along with the three-dimensional coordinates used to define points along the panel boundaries.

6.3.1 Input Data

Input to CBMVM is similar to that of CBMCM, except that adjacent panels and edges can be combined into panels for input to CBMVM.

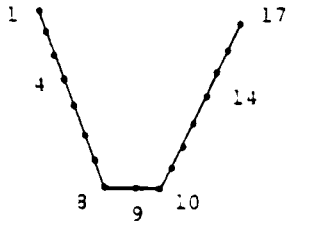
The program CBMCM is set up to accept any three dimensional cartesian coordinate system. The user must also supply the program with the three-dimensional coordinates of the Seat Reference Point (SRP) with respect to the origin of crew station coordinate system.



WINDSCREEN, FRONT TOP (17)

POINT:	x	y	z
1.	227.63	5.84	125.35
2.	223.79	5.51	123.24
3.	220.98	5.46	121.57
4.	218.93	5.19	120.59
5.	215.79	4.86	118.76
6.	213.14	4.27	117.35
7.	211.09	3.62	116.16
8.	209.14	2.81	115.84

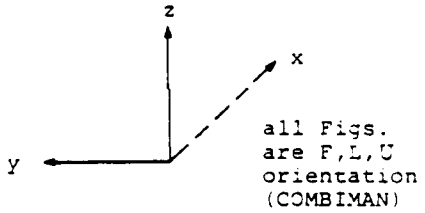
(Points 10-17 are the same as 8-1 with the sign of the y value changed)



WINDSCREEN, FRONT BOTTOM (17)

POINT:	x	y	z
1.	227.63	5.84	125.35
2.	230.00	5.78	126.65
3.	232.12	5.68	127.84
4.	234.44	5.41	129.03
5.	237.31	4.70	130.59
6.	239.41	4.05	131.73
7.	241.09	2.92	132.86
8.	242.12	2.00	133.41
9.	242.12	0.00	133.41

(Points 10-17 are the same as 8-1 with the sign of the y value changed)



COCKPIT CANOPY CLEARLINE (92)

	x	y	z		x	y	z		x	y	z
1.	294.47	0.00	135.50	16.	286.78	19.41	116.98	31.	255.59	17.03	114.30
2.	294.34	2.47	134.60	17.	285.96	19.30	116.76	32.	254.69	16.97	114.60
3.	293.61	6.22	133.26	18.	284.71	19.30	116.54	33.	252.92	15.78	115.77
4.	293.22	8.32	132.01	19.	282.81	19.14	116.41	34.	251.92	14.70	117.45
5.	292.61	10.54	130.24	20.	281.34	19.08	116.29	35.	251.32	13.89	118.57
6.	292.09	12.43	128.60	21.	279.87	18.97	116.16	36.	250.69	13.35	119.70
7.	291.62	13.78	127.00	22.	277.67	18.86	115.94	37.	250.69	13.35	119.70
8.	291.14	15.03	125.57	23.	275.72	18.65	115.77	38.	249.55	11.78	122.38
9.	290.67	15.89	124.15	24.	273.35	18.49	115.55	39.	249.07	10.97	124.20
10.	290.32	17.30	122.38	25.	270.30	18.38	115.33	40.	248.73	10.16	125.50
11.	289.59	18.35	120.86	26.	268.94	18.82	115.16	41.	248.71	8.81	127.30
12.	289.07	18.86	119.44	27.	267.13	18.00	114.99	42.	247.82	7.84	128.50
13.	288.55	19.51	118.32	28.	264.97	17.89	114.86	43.	247.43	6.32	130.30
14.	287.95	19.46	117.71	29.	260.73	17.61	114.42	44.	247.08	4.97	132.00
15.	287.43	19.46	117.32	30.	258.53	17.24	114.95	45.	246.79	2.81	134.50
								46.	246.61	0.00	135.00

(Points 47-92 are the same as 45-1 with the sign of the y value changed)

Figure 77. X, Y and Z Coordinates of A7E-01 Boundaries.

Directions of the x, y, and z axes are A for aft, F for forward, L for left, R for right, U for up, and D for down. CBMVM converts the given coordinates to the COMBIMAN coordinate system (x=F, y=L, z=U, and SRP=(0,0,0)). (See Figure 77.)

Panels for crew stations may have a maximum of 100 vertices. These vertices must be input consecutively, going either clockwise or counterclockwise along the perimeter of the panel as explained in Paragraph 6.3.2.1.

6.3.2 Specifying Processing Desired

Program CBMVM allows the user the same functions as program CBMCM excluding the function to punch the member (PCH). The function request formats are punched one request per card and are shown in Figure 78. The &INT card is used to initialize the Data Base; the other control cards can be used anytime and in any order. The format and necessary parameters of the control cards are explained in the following paragraphs.

6.3.2.1 ADD VISIBILITY MEMBER Function

&ADD membername type nbnds srpx srpy srpz x y z xx yy zz (followed by visibility member definition).

The ADD VISIBILITY MEMBER function adds the specified data under the member name membername to the Visibility Data Base. The membername is limited to a maximum length of eight characters. Type is a two-digit right justified integer that can be either 0 or 1. If type=0, the program checks the panel vertices for clockwise or counterclockwise entries. Type=1 avoids this test. Nbnds is a right justified three-digit integer, that specifies the number of panels associated with a membername. The SRP coordinates are srpx, srpy, and srpz and are entered as real numbers of 6 digits or less. A decimal point, omitted, is inserted by the program in-between the second and the third digits from the right. X, Y, and Z indicate the directions of the positive x, y, and z coordinates respectively, (A, F, L, R, U or D). xx, yy, zz are two letter abbreviations for the axis labels and

directions of the input coordinate system when the operator is seated in the crew station. Examples of these values are FS (fuselage station-aft), WL (waterline-up), or BL (buttline-right).

Each panel is defined by a card containing its sequence number (seq.#), panelname, and number of coordinates (# coord) within the panel, and number of vertices, one to a card. Figure 79 shows the format for these input cards.

Seq.# and # coord are 3-digit right justified integers; the panelname can be up to 28 characters long. The three-dimensional coordinates are input as 6-digit, real numbers, one set to a card. A decimal point, if omitted, is inserted between the second and the third digits from the right.

An example of the ADD VISIBILITY MEMBER function is shown in Figure 80. The first outlined area contains the &ADD control card. The associated panels consists of a panel name card (area 2) followed by the specified number of three-dimensional coordinate data cards shown in the third outlined area.

If the program detects an error in the input data the member will not be added to the Data Base.

6.3.2.2 CHECK VISIBILITY MEMBER Function

&CHK membername type nbnds srpx srpy srp
x y z xx yy zz (followed by visibility workspace definition).

The CHECK VISIBILITY MEMBER function operates in the same way the ADD VISIBILITY MEMBER function does except that the member is not added, but is only checked for errors.

6.3.2.3 DELETE VISIBILITY MEMBER Function

&DEL membername

The DELETE VISIBILITY MEMBER function removes a given membername from the Data Base. In order to make the space occupied by the deleted member available, COMPRESS VISIBILITY MEMBER function must be used.

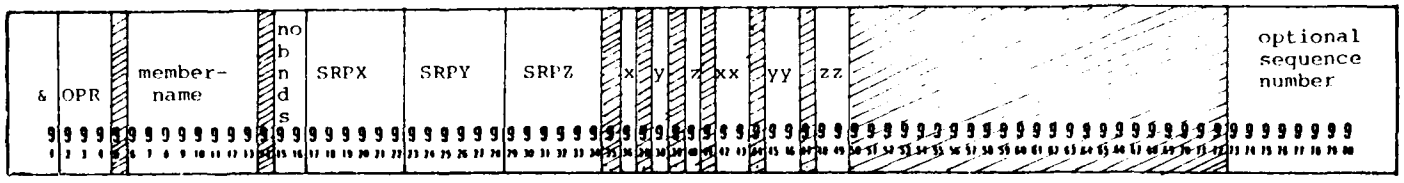


Figure 78. Program CBMVM Control Card Format.

(a)

(b)

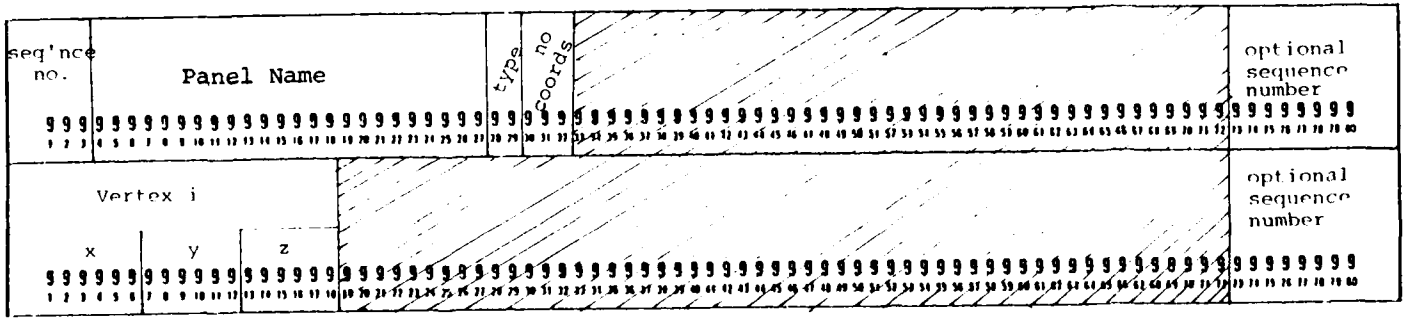


Figure 79. (a) Program CBMVM Member Card Format for Panels.
(b) Program CBMVM Member Card Format for Coordinates of Panels.

```
&ADD 17E-01    3 270.0   0.0 99.15 F L J FS BL WL                    1
001*WINDSCREEN, FRONT BOTTOM    17                                  2
  22763   584 12535
  22579   551 12324
  22098   540 12157
  21893   519 12059
  21579   480 11870
  21314   427 11735
  21109   382 11610                                                 3
  20914   281 11584
  20914   000 11584
  20914  -281 11584
  21109  -382 11610
  21314  -427 11735
  21579  -487 11870
  21893  -519 12059
  22098  -540 12157
  22379  -551 12324
  22763  -584 12535
002*WINDSCREEN, FRONT TOP       17
  22763   584 12535
  23000   578 12005
  23212   568 12784
  23444   541 12903
  23731   470 13059
  23941   405 13173
  24109   292 13286
  24212   200 13341
  24212   000 13341
  24212  -200 13341
  24109  -292 13286
  23941  -405 13173
  23731  -470 13059
  23444  -541 12901
  23212  -568 12784
  23000  -578 12005
  22763  -584 12535
003COCKPIT CANOPY CLEARLINE 1 92
  29447   000 13550
  29404   247 13460
  29301   622 13320
  29322   832 13201
  29251  1054 13024
  29209  1243 12850
  29102  1378 12700
  29114  1503 12557
  29067  1569 12415
  29002  1730 12238
           .
           .
           .
  29209 -1243 12858
  29201 -1054 13024
  29322 - 832 13201
  29301 - 622 13326
  29404 - 247 13460
  29447   000 13550
```

Figure 80. Sample Data for &ADD Member Function.

6.3.2.4 COMPRESS VISIBILITY DATA BASE Function &CMP

The COMPRESS VISIBILITY DATA BASE function compresses used space and maximizes the continuous unused space for the Visibility Data Base.

If the message "CBM527A NO SPACE, CANNOT ADD membername" is encountered during an &ADD operation, it is necessary to compress first and then attempt to add again. If the message reappears, the Data Base is full.

6.3.2.5 DUMP VISIBILITY MEMBER Function

&DMP membername or
&DMP

The DUMP VISIBILITY MEMBER function prints the entire contents of the visibility member membername or the complete Visibility Data Base if no name is specified. The format of the output is as follows:

```
RECORD nn
+=+ first half of record in EBCDIC  +=+
+=+ second half of record in EBCDIC +=+
+=+ complete                        +=+
+=+        record                   +=+
+=+              in                 +=+
+=+                Hexadecimal      +=+
```

where:

nn - is the number of record on the data base and
+=+ - is delimeter for the data.

The use of this function is primarily as a debugging aid for Input/Output errors.

6.3.2.6 PRINT VISIBILITY MEMBER Function

&PRT membername or
&PRT

The PRINT VISIBILITY MEMBER function prints the specified membername in a format similar to the ADD VISIBILITY MEMBER function. Specifying no name or a nonexistent name causes a printout of the list of members and their extents on the Data Base, as well as their origin and orientation.

6.3.2.7 INITIALIZE VISIBILITY MEMBER Function

&INT

The INITIALIZE VISIBILITY MEMBER function is used primarily to establish a Data Base, although it may be used to return the data base to its original unused state.

6.3.2.8 END PROGRAM Function

&END

The END PROGRAM function terminates execution of the program CBMVM.

6.3.3 Submitting a Processing Request

The sequence of Job Control Language (JCL) cards needed to execute the program CBMVM are shown in Figure 81a. Initialization of the Data Base for the first time requires allocation of space on disk for the Data Base and is accomplished by the "//FTØ9FØØ1 DD" cards shown in Figure 81b and the $INT control card initializes the Data Base. The "//FTØ9FØØ1" card in Figure 81a is used for all subsequent processing requests. Always end a run with the &END control card.

6.3.4 Interpreting the Output

Output generated by the program CBMVM, which controls page formatting and identifies each page with the source program (CBMVM) name, date, and time of program execution, and page number, falls into five format types.

```
//CBMVM    JOB MESS                                                  00001000
//JOBLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR                          00001100
//CBMVM    EXEC PGM=CBMVM                                            00001200
//FT05F001 DD DDNAME=SYSIN                                           00001300
//FT06F001 DD SYSOUT=A                                               00001400
//FT07F001 DD SYSOUT=B                                               00001500
//FT09F001 DD DSN=COMBIMAN.VISDATA,DISP=SHR                          00001600
//SYSUDUMP DD SYSOUT=A                                               00001700
//SYSIN    DD *                                                      00001800

         CBMVM FUNCTION CONTROL CARDS AND
            MEMBER DEFINITION DATA

/*                                                                   00001900
//
```

Figure 81a. Job Control Cards to Execute CBMVM.

```
//FT09F001 DD DSN=COMBIMAN.VISDATA,UNIT=DISK,DISP=(NEW,CATLG),       00001600
//            VOL=SER=DISK01,SPACE=(240,2000),                       00001610
//            DCB=(BLKSIZE=240,LRECL=240,RECFM=FB)                   00001620
```

Figure 81b. FT09 DD Card to Allocate Space for COMBIMAN.VISDATA and Execute Program CBMVM.

The first type of output is generated by the &INT, &CMP, &DEL and &END functions. The output for these functions indicates the start and end of processing associated with the specified function. The COMPRESS function, however, generates additional messages indicating that a certain member was, or was not, moved in the process of combining unused space. An example of this format, for the COMPRESS function, is shown in Figure 82.

The second type of output is generated by the PRINT function with a blank membername field. This causes a listing of the entire directory for the Data Base in the following format:

```
nn.) membername, EXTENT (n1, n2), nb PANELS,
                 ORIGIN = (x,y,z), ORIENT = (a,b,c),
                 AXES HEADINGS = (xx, yy, zz)
```

where:

nn	identifies the record number of the member within the directory
membername	is the 8 character name of the member at record nn
n1	is the location of first record of membername
n2	is the location of last record of membername
nb	is the number of panels associated with the member
x, y, z	is the location of the SRP in the original coordinate system
a, b, c	are the original orientation of the positive x, y, and z axes, respectively
xx, yy, zz	are the original axes headings for the positive x, y and z axes, respectively.

This information was originally supplied to the Data Base by the &ADD control card. An example of the output of the &PRT function is shown in Figure 83.

```
CBMVM --- VISIBILITY DATA BASE MAINTENANCE PROGRAM                    // 7777  11.30. 0  PAGE   1

CBM500I &CMP
CBM528I BI-NAV01 WAS IN PLACE.
CBM528I AZE-01   WAS IN PLACE.
CBM538I COMPRESS FINISHED.
```

Figure 82. A Sample Output of &CMP Function.


```
CBMVM - - VISIBILITY DATA BASE MAINTENANCE PROGRAM                    // 7777   0. 0.36  PAGE   9

BM500I &PRT
        17.1 BI-NAV1A, EXTENT=(      38,      461,   7 BOUNDARIES, ORIGIN=( 396.50,  22.33,  62.50), ORIENT.=(A,P,I)
                       AXES HEADINGS =(EES,BE,WE).
        20.1 AZE-01  , EXTENT=(      31,      371,   3 BOUNDARIES, ORIGIN=( 270.60,   0.0 ,  99.15), ORIENT.=(E,E,U)
                       AXES HEADINGS =(EES,BE,WE).
        21.1 BI-NAV01, EXTENT=(      22,      301,   7 BOUNDARIES, ORIGIN=( 396.60,  22.00,  62.50), ORIENT.=(A,P,U)
                       AXES HEADINGS =(EES,BE,WE).
```

Figure 83. A Sample Output of &PRT Function.

The third type of output is generated by the DUMP function. For the member specified on the &DMP control card, the directory information in the second format is printed first. It is followed by records of the member printed in the format shown in Paragraph 6.3.2.5. The record in EBCDIC is printed in a 30A4 format and for the hexadecimal output, 15Z8 format is used.

The DUMP function is used primarily as a debugging aid for Input/Output errors. An example of the DUMP function output is shown in Figure 84.

The fourth output format is used by the CHECK and ADD functions. The first item printed out is a reformatting of the information on the control card. Then, each panel definition along with its input and absolute coordinates is printed. The format is:

nn.) bndnm,nv VERTICES - INPUT COORD--ABSOLUTE COORD--

(x_{11}, y_{11}, z_{11}) to (x_{21}, y_{21}, z_{21})

" " " " " "

" " " " " "

$(x_{1nv}, y_{1nv}, z_{1nv})$ to $(x_{2nv}, y_{2nv}, z_{2nv})$

where:

nn	is the panel sequence number
bndnm	is the boundary name (8 characters or less)
nv	is the number of vertices for the panel
x_{1i}, y_{1i}, z_{1i}	coordinate of i^{th} vertex of the panel in the original system of coordinates (i=1,nv)
x_{2i}, y_{2i}, z_{2i}	coordinates of the i^{th} vertex of the panel, converted to the COMPIMAN coordinate system (i=1,nv)

An example of the output generated by the &ADD function is shown in Figure 85.

The fifth and last format is used by the PRINT function. In this output the original input coordinates are not printed. The directory information printed first is followed by the panel definition cards:

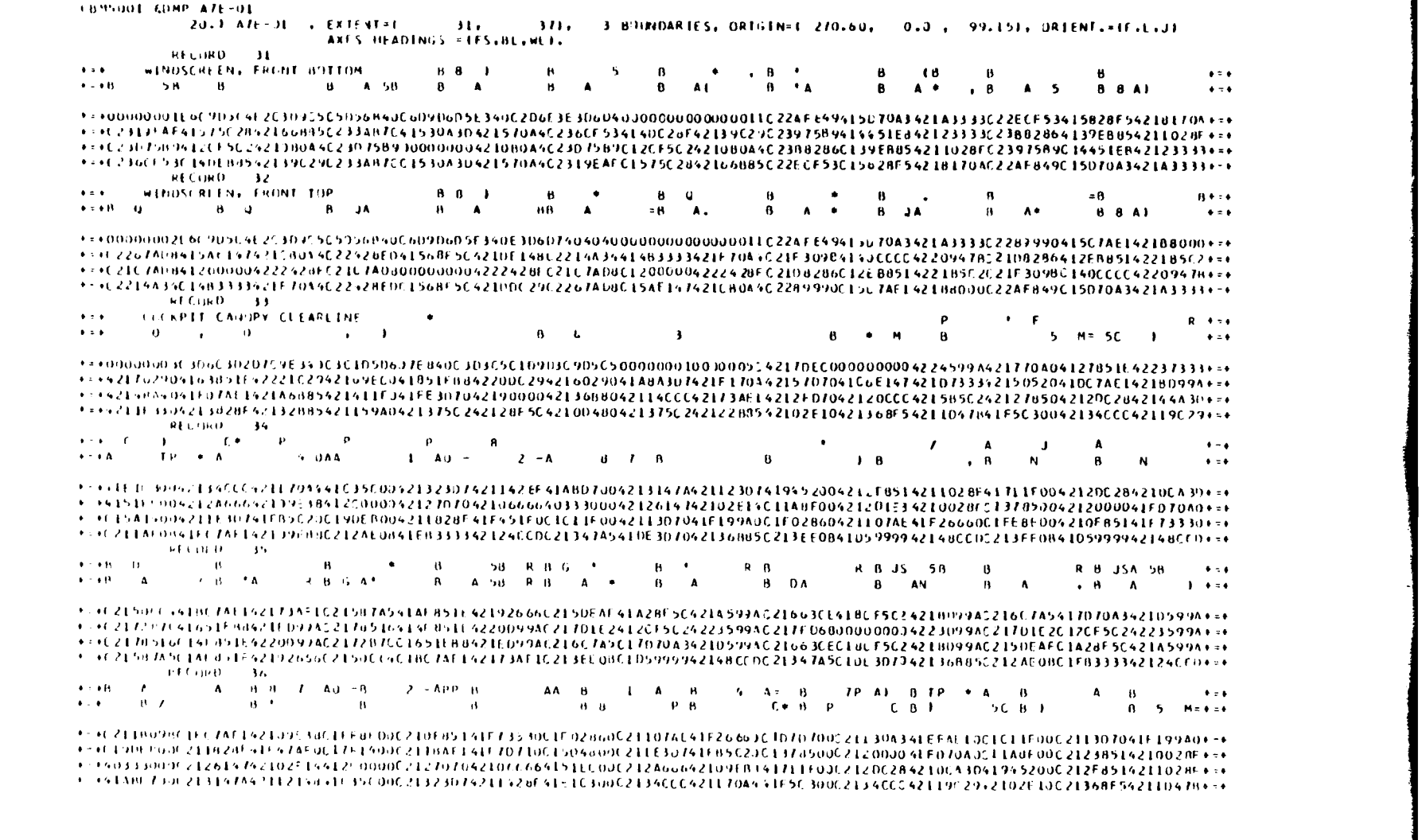


Figure 84. A Sample Output of &DMP Function.

```
CBM50.1 CALL AZE-01     3270.00   0.0   99.15 F L U FS BL WL
CBM51?1 MEMBER, AZE-01   , HAS    3 BOUNDARIES.
CBM52?1 COORDINATES ARE TRANSLATED TO ( 270.60,    0.0 ,   99.15).
CBM52?1 COORDINATES GIVEN AS F, L AND U ARE NOW F, L, AND U.
CBM52?1 AXES HEADINGS ARE FS, BL AND WL.
        1.1 WINDSCREEN, FRONT BOTTOM TYPE= 0  17 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                                ( 227.63   5.84 125.35)  TO  ( -42.97   5.84   26.20)
                                                ( 223.79   5.51 123.24)  TO  ( -46.81   5.51   24.09)
                                                ( 220.98   5.46 121.57)  TO  ( -49.62   5.46   22.42)
                                                ( 218.93   5.19 120.59)  TO  ( -51.67   5.19   21.44)
                                                ( 215.79   4.86 118.76)  TO  ( -54.81   4.86   19.61)
                                                ( 213.14   4.27 117.35)  TO  ( -57.46   4.27   18.20)
                                                ( 211.09   3.62 116.16)  TO  ( -59.51   3.62   17.01)
                                                ( 209.14   2.81 115.84)  TO  ( -61.46   2.81   16.69)
                                                ( 209.14   0.0  115.84)  TO  ( -61.46   0.0    16.69)
                                                ( 209.14  -2.81 115.84)  TO  ( -61.46  -2.81   16.69)
                                                ( 211.09  -3.62 116.16)  TO  ( -59.51  -3.62   17.01)
                                                ( 213.14  -4.27 117.35)  TO  ( -57.46  -4.27   18.20)
                                                ( 215.79  -4.87 118.76)  TO  ( -54.81  -4.87   19.61)
                                                ( 218.93  -5.19 120.59)  TO  ( -51.67  -5.19   21.44)
                                                ( 220.98  -5.46 121.57)  TO  ( -49.62  -5.46   22.42)
                                                ( 223.79  -5.51 123.24)  TO  ( -46.81  -5.51   24.09)
                                                ( 227.63  -5.84 125.35)  TO  ( -42.97  -5.84   26.20)
        2.1 WINDSCREEN, FRONT TOP     TYPE= 0  17 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                                ( 227.63   5.84 125.35)  TO  ( -42.97   5.84   26.20)
                                                ( 230.00   5.78 126.65)  TO  ( -40.60   5.78   27.50)
                                                ( 232.12   5.68 127.84)  TO  ( -38.48   5.68   28.69)
                                                ( 234.44   5.41 129.03)  TO  ( -36.16   5.41   29.88)
                                                ( 237.31   4.70 130.59)  TO  ( -33.29   4.70   31.44)
                                                ( 239.41   4.05 131.73)  TO  ( -31.19   4.05   32.58)
                                                ( 241.09   2.92 132.86)  TO  ( -29.51   2.92   33.71)
                                                ( 242.12   2.00 133.41)  TO  ( -28.48   2.00   34.26)
                                                ( 242.12   0.0  133.41)  TO  ( -28.48   0.0    34.26)
                                                ( 242.12  -2.00 133.41)  TO  ( -28.48  -2.00   34.26)
                                                ( 241.09  -2.92 132.86)  TO  ( -29.51  -2.92   33.71)
                                                ( 239.41  -4.05 131.73)  TO  ( -31.19  -4.05   32.58)
                                                ( 237.31  -4.70 130.59)  TO  ( -33.29  -4.70   31.44)
                                                ( 234.44  -5.41 129.01)  TO  ( -36.16  -5.41   29.86)
                                                ( 232.12  -5.68 127.84)  TO  ( -38.48  -5.68   28.69)
                                                ( 230.00  -5.78 126.65)  TO  ( -40.60  -5.78   27.50)
                                                ( 227.63  -5.84 125.35)  TO  ( -42.97  -5.84   26.20)
        3.1 COCKPIT CANOPY CLEARLINE TYPE= 1  92 VERTICES --INPUT COORDINATES---      --ABSOLUTE COORDINATES-
                                                ( 294.47   0.0  135.53)  TO  (  23.87   0.0    36.35)
                                                ( 294.04   2.47 134.60)  TO  (  23.44   2.47   35.45)
                                                ( 293.61   6.22 133.26)  TO  (  23.01   6.22   34.11)
                                                ( 293.22   8.32 132.01)  TO  (  22.62   8.32   32.86)
                                                ( 292.61  10.54 130.24)  TO  (  22.01  10.54   31.07)
                                                ( 292.09  12.43 128.60)  TO  (  21.49  12.43   29.45)
                                                ( 291.62  13.78 127.00)  TO  (  21.02  13.78   27.85)
                                                ( 291.14  15.03 125.57)  TO  (  20.54  15.03   26.42)
                                                ( 290.67  15.89 124.15)  TO  (  20.07  15.89   25.00)
```

Figure 85. A Sample Output of CBMVM &ADD Function.

nn.) bndnm, nv VERTICES -- ABSOLUTE COORDINATES

(x_1, y_1, z_1)

" " "

" " "

(x_{nv}, y_{nv}, z_{nv})

where:

nn	is the panel sequence number
bndnm	is the panel name (8 characters or less)
nv	is the number of vertices which constitute the panel

An example of this format is shown in Figure 86.

6.4 PROGRAM MESSAGES - INCLUDING ERROR CORRECTION

The program CBMVM prints out information and action related messages. The message format is:

CBM5nni message text

where:

nn	is the message number
i	indicates the action code (I=informational, A=action to be performed).
message text	is the text of the message.

CBM500I control card image
Reason: User has submitted a control card.
System Action: None.
User Action: None.

CBM501A operation UNKNOWN OPERATION.
Reason: The operation on the control card (shown in the previous CBM500I message) is unknown.
System Action: This control card is ignored.
User Action: Correct the card and resubmit.

CBM503A vertexnumber INVALID VERTEX NUMBER FOR POLY panelname.
Reason: The order in which the vertices are given is not in a clockwise or counterclockwise direction.
System Action: Vertex number 1 is used.
User Action: Delete the member, correct the error and resubmit.

```
CBM5001 &PRT AZE-01
 23.) AZE-01   , EXTENT=(      31,      37),   3 BOUNDARIES, ORIGIN=( 270.53,    0.0 ,   99.151), ORIENT.=(E,E,D)
                AXES HEADINGS =(FS,BE,WE).
  1.) WINDSCREEN, FRONT BOTTOM TYPE= 0  17 VERTICES --ABSOLUTE,COORDINATES-
                                                    ( -42.97    5.84   26.20)
                                                    ( -46.81    5.51   24.09)
                                                    ( -49.62    5.46   22.42)
                                                    ( -51.67    5.19   21.44)
                                                    ( -54.81    4.86   19.61)
                                                    ( -57.46    4.27   18.20)
                                                    ( -59.51    3.62   17.01)
                                                    ( -61.46    2.81   16.69)
                                                    ( -61.46    0.0    16.69)
                                                    ( -61.46   -2.81   16.69)
                                                    ( -59.51   -3.62   17.01)
                                                    ( -57.46   -4.27   18.20)
                                                    ( -54.81   -4.87   19.61)
                                                    ( -51.67   -5.19   21.44)
                                                    ( -49.62   -5.46   22.42)
                                                    ( -46.81   -5.51   24.09)
                                                    ( -42.97   -5.84   26.20)
  2.) WINDSCREEN, FRONT TOP    TYPE= 0  17 VERTICES --ABSOLUTE,COORDINATES-
                                                    ( -42.97    5.84   26.20)
                                                    ( -40.60    5.78   27.50)
                                                    ( -38.48    5.68   28.69)
                                                    ( -36.16    5.41   29.88)
                                                    ( -33.29    4.70   31.44)
                                                    ( -31.19    4.05   32.58)
                                                    ( -29.51    2.92   33.71)
                                                    ( -28.48    2.00   34.26)
                                                    ( -28.48    0.0    34.26)
                                                    ( -28.48   -2.00   34.26)
                                                    ( -29.51   -2.92   33.71)
                                                    ( -31.19   -4.05   32.58)
                                                    ( -33.29   -4.70   31.44)
                                                    ( -36.16   -5.41   29.86)
                                                    ( -38.48   -5.68   28.69)
                                                    ( -40.60   -5.78   27.50)
                                                    ( -42.97   -5.84   26.20)
  3.) COCKPIT CANOPY CLEARLINE TYPE= 1  92 VERTICES --ABSOLUTE,COORDINATES-
                                                    (  23.67    0.0    36.35)
                                                    (  23.44    2.47   35.45)
                                                    (  23.01    6.22   34.11)
                                                    (  22.62    8.32   32.86)
                                                    (  22.01   10.54   31.09)
                                                    (  21.49   12.43   29.45)
                                                    (  21.02   13.78   27.85)
                                                    (  20.54   15.03   26.42)
                                                    (  20.07   15.89   25.00)
                                                    (  19.42   17.30   23.23)
                                                    (  18.99   18.05   21.71)
                                                    (  18.47   18.86   20.29)
```

Figure 86. A Sample Output of CBMVM &PRT Function.

CBM505A NO NAME GIVEN, operation IGNORED.
Reason: This operation requires a member name, but none was supplied.
System Action: The operation is ignored.
User Action: Supply the member name and resubmit.

CBM506A membername NOT FOUND.
Reason: For the Delete function (&DEL), Dump function (&DMP), or Print function (&PRT) the specified visibility member name does not exist.
System Action: The directory of the visibility data base is printed, instead of the requested function.
User Action: Check the control card for non-existent member name.

CBM507A NUMBER OF PANELS INVALID FOR MEMBER membername.
Reason: The number of panels as specified on the ADD function control card (&ADD) is either less than 1 or greater than 15.
System Action: The control card is ignored.
User Action: Correct and resubmit.

CBM508A axis FOR X INVALID, MEMBER IS membername.
Reason: During the Add function (&ADD), the direction of the user's X-axis is not F, A, L, R, U or D.
System Action: The control card is ignored.
User Action: Correct and resubmit.

CBM509A axis FOR Y INVALID, MEMBER IS membername.
Reason: During the Add function (&ADD), the direction of the user's Y-axis is not F, A, L, R, U or D.
System Action: The control card is ignored.
User Action: Correct and resubmit.

CBM510A axis FOR Z INVALID, MEMBER IS membername.
Reason: During the Add function (&ADD), the direction of the user's Z-axis is not F, A, L, R, U or D.
System Action: The control card is ignored.
User Action: Correct and resubmit.

CBM511A X&Y, X&Z OR Y&Z ARE COLINEAR FOR MEMBER membername.
Reason: The directions of two axes are the same (ex. X=L & Y=U & Z=U).
System Action: The control card is ignored.
User Action: Pick unique directions for the axes and resubmit.

CBM512A DIRECTORY IS FULL, CANNOT ADD membername.
Reason: No space is left in the Visibility Data Base directory to add an entry for this member.
System Action: The control card is ignored.
User Action: Increase the directory space and resubmit.

CBM514A membername ALREADY EXISTS.
Reason: User has tried to add a member definition under a name that already exists in the Data Base.
System Action: The control card is ignored.
User Action: Use a new name, and resubmit.

CBM515A END OF DATA.
Reason: The end of file was found before the END Program control card (&END).
System Action: The program is ended.
User Action: Check to make sure that all the control cards were processed.

CBM516A I/O ERROR ON RECORD recordnumber (INDEX).
Reason: An I/O error occurred on the Visibility Data Base.
System Action: Terminates the program.
User Action: Contact Systems Programmer.

CBM517A I/O ERROR ON RECORD recordnumber (DATA).
Reason: An I/O error occurred on the Visibility Data Base.
System Action: Terminates the program.
User Action: Contact systems programmer.

CBM519I NEW MEMBER, membername, HAS nn PANELS.
Reason: The user has added a member definition to the Data Base.
System Action: The addition is accepted.
User Action: None.

CBM520I COORDINATES ARE TRANSLATED TO seat reference point coordinate.
Reason: The user added a member definition to the Data Base.
System Action: The addition is accepted.
User Action: None.

CBM521I COORDINATES GIVEN AS axis, axis AND axis ARE NOW F, L, AND U.
Reason: The user added a member definition to the Data Base.
System Action: The addition is accepted.
User Action: None.

CBM522I AXES HEADINGS ARE xx, yy, AND zz.
Reason: The user added a member definition to the Data Base.
System Action: The addition is accepted.
User Action: None.

CBM523I membername DELETED.
Reason: The user submitted a DELETE Visibility Definition function control card (&DEL).
System Action: The requested deletion was made.
User Action: None.

CBM524I INITIALIZED.
Reason: The user requested that the Visibility Data Base be initialized via the Initialize Visibility Data Base Function (&INT).
System Action: The data base is initialized.
User Action: None.

CBM527A NO SPACE, CANNOT ADD membername.
Reason: There is not enough space in the data base to hold the requested addition.
System Action: The control card is ignored.
User Action: Increase the space for the Visibility Data Base.

CBM528I membername WAS IN PLACE.
Reason: The user requested the data base be compressed. The member, membername was already compressed, and not moved.
System Action: The member was not moved.
User Action: None.

CBM529I membername NOW IN PLACE.
Reason: The user requested the data base be compressed, the member, membername was not in place, and therefore has been compressed.
System Action: The member is compressed.
User Action: None.

CBM531A panelname HAS SAME NUMBER AS panelname.
Reason: In adding a contour definition, two panels have the same panel number.
System Action: Both panels are accepted. Note that references to the second will cause a reference to the first.
User Action: Delete the member definition, correct the error, and resubmit.

CBM532I PROGRAM END.
Reason: The End Program function control (&END) card, or the end of file card was encountered, or there was an I/O error, or there was an unknown operation.
System Action: Terminates program.
User Action: Make sure that all control cards were accepted, and processed correctly.

CBM534I membername WITH nn PANELS HAS BEEN ADDED.
Reason: Member has been successfully added.
System Action: Reads next control card.
User Action: None.

CBM535A membername NOT ADDED DUE TO nn ERRORS.
Reason: During &ADD operation, the system found nn errors.
System Action: Reads next control card; member not added.
User Action: Correct error and resubmit.

CBM536I MEMBER membername CHECKED, nn ERRORS.
Reason: During &CHK, the system found nn errors.
System Action: Reads next control card.
User Action: Correct and resubmit.

CBM537A DATA BASE IS NOT VISIBILITY DATA BASE.
Reason: First record in directory contains a keyword 'IVIS' to identify a Visibility Data Base. We accessed a data base without that keyword.
System Action: Terminates program.
User Action: Check JCL cards and access correct data base.

CBM538I COMPRESS FINISHED.
Reason: Compress successful.
System Action: Reads next control card.
User Action: None.

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APPENDIX A

COMBIMAN DISTRIBUTION TAPE DOCUMENTATION

4. CONTENTS

COMBIMAN DISTRIBUTION TAPE IS AN IBM STANDARD LABEL, 9TRACK, 1600BPI, DENSITY=3, PARITY=ODD, REMOVE TAPE CONTAINING THE PARTITIONED DATA SETS AND SIX SEQUENTIAL DATA SETS. THE VOLUME SERIAL FOR THE DISTRIBUTION TAPE IS CBMTPE. THE CHARACTERISTICS OF THE DATA SETS ARE DESCRIBED IN THE FOLLOWING TABLE.

DATASET	FILE	LRECL	RECFM	BLKSIZE	ORGANIZATION
COMBIMAN.TPDOCMNT	1	80	FB	800	SEQUENTIAL
COMBIMAN.LOADLIB	2		U	13030	PARTITIONED
COMBIMAN.SOURCE	3	80	FB	800	PARTITIONED
COMBIMAN.ANTHDATA	4	248	FB	248	SEQUENTIAL
COMBIMAN.CRSTDATA	5	368	FB	368	SEQUENTIAL
COMBIMAN.INITDATA	6	104	VBS	3280	SEQUENTIAL
COMBIMAN.SMPLANTH	7	80	FB	800	SEQUENTIAL
COMBIMAN.VISDATA	8	240	FB	240	SEQUENTIAL

THE FIRST FILE ON THE TAPE IS A SEQUENTIAL FILE AND CONTAINS THE DESCRIPTION OF THE DATA SETS ON THE TAPE AND THE INSTALLATION PROCEDURE IN CARD IMAGE FORMAT (SEE APPENDIX A).

THE SECOND FILE CONTAINS THE LOAD MODULES CBMC04, CBMAN, CBMCM, AND CBMVM MEMBERS OF THE PARTITIONED DATA SET COMBIMAN.LOADLIB. A LINK EDIT MAP OF THESE LOAD MODULES IS GIVEN IN APPENDIX B-1, 2, 3, AND 4 OF THE COMBIMAN USER'S GUIDE.

FILE 3 CONTAINS SOURCE MODULES CBMCP2, CBMCP3, CBMCP4, AND CBMOFF AS MEMBERS OF THE PARTITIONED DATA SET COMBIMAN.SOURCE. THE GRAPHIC SUBROUTINE CALLS IN CBMCP2, CBMCP3, AND CBMCP4 ARE WRITTEN FOR A GOULD 4500 ELECTROSTATIC PLOTTER. THE USERS MAY HAVE TO CHANGE THESE CODES AND COMPILE AND LINK EDIT THESE SUBROUTINES TO CBMC04 TO USE THE PLOTTER AT THEIR SITE. CBMOFF, THE FOURTH MEMBER, IS THE OFFLINE PLOT ROUTINE. IT USES DATA GENERATED ON UNIT 11 DURING A COMBIMAN RUN WHEN PER7 IS ACTIVATED. THE CODE IN CBMOFF MODULE IS WRITTEN FOR A CALCOMP PLOTTER. LISTINGS OF THESE SOURCE MODULES ARE IN APPENDIX C.

FILES 4 THROUGH 8 ARE SEQUENTIAL DATA SETS AND CONTAIN DATA NECESSARY TO EXECUTE CBMC4. IN FILE FOUR THE DATA SET COMBIMAN.ANTHDATA, DESCRIBED IN SECTION 4 OF COMBIMAN USER'S GUIDE, HAS THE ANTHROPOMETRIC SURVEY AND REGRESSION DATA FOR 1967 USAF PILOTS AND 1970 US ARMY PILOTS. THE JCL CARDS, CONTROL CARDS, AND DATA NECESSARY TO CREATE THIS DATA SET ARE LISTED IN APPENDIX C.

FILE 5 HAS THE COMBIMAN.CRSTDATA DATA SET WHICH CONTAINS THE SEAT, PANEL, AND CONTROL DATA FOR THE A7E-01 CREW STATION CONFIGURATION. THE JCL CARDS, CONTROL CARDS, AND DATA USED TO CREATE THIS DATA SET ARE IN APPENDIX E.

FILE 6 HAS THE DATA SET COMBIMAN.INITDATA WHICH CONTAINS DATA NECESSARY TO GENERATE THE COMBIMAN LINK SYSTEM AND PROMPTING MESSAGES.

FILE 7 HAS THE DATA SET COMBIMAN.SMPLANTH WHICH CONTAINS 16 SETS OF SAMPLE ANTHROPOMETRY FOR THE CARD INPUT OPTION OF THE INPUT 12 ANTHROPOMETRIC DIMENSIONS FUNCTION (SEE SECTION 2.2.12 AND FIGURE 27 OF THE USER'S GUIDE).

FILE 8 HAS THE DATA SET COMBIMAN.VISDATA WHICH CONTAINS THE VISIBILITY DATA (SEE SECTION 6 OF COMBIMAN USER'S GUIDE) FOR THE A7E-01 CREW STATION CONFIGURATION. THE JCL CARDS, CONTROL CARDS, AND DATA USED TO CREATE THIS DATA SET ARE IN APPENDIX F.

8. INSTALLATION PROCEDURE

THE GENERAL PROCEDURE DESCRIBED HERE TO COPY A DATA SET FROM COMBIMAN DISTRIBUTION TAPE TO DISK CONSISTS OF TWO STEPS. THE FIRST STEP ALLOCATES SPACE FOR THE DATA SET TO DISK USING PGM=IEFBR14. THE SECOND STEP COPIES THE DATA SET TO DISK USING PGM=IEHMOVE.

```
//ALLOCATE JOB
//ALLOC    EXEC
//DD1      DD DSN=COMBIMAN.TPDOCMNT,DISP=(NEW,CATLG,DELETE),
//         SPACE=(TRK,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800),
//         UNIT=DISK,VOL=SER=VOLUME
//
```

THE DCB PARAMETERS FOR ALL THE DATA SETS ARE GIVEN IN THE TABLE IN SECTION A. THE SPACE PARAMETERS FOR THE DATA SETS ARE:

DATASET	SPACE PARAMETER
COMBIMAN.TPDOCMNT	(TRK,(1,1))
COMBIMAN.LOADLIB	(TRK,(20,10,5))
COMBIMAN.SOURCE	(TRK,(5,1,2))
COMBIMAN.ANTHDATA	(246,2000)
COMBIMAN.CRSTDATA	(366,2000)
COMBIMAN.INITDATA	(TRK,(1,1))
COMBIMAN.SMPLANTH	(TRK,(1,1))
COMBIMAN.VISDATA	(246,2000)

THE 'VOLUME' IN VOL=SER=VOLUME SHOULD BE CHANGED TO REFLECT THE DISK VOLUME.

THE JCL TO COPY A PARTITIONED DATA SET, COMBIMAN.LOADLIB,
FROM CBMTPE FILE 2 IS:

```
//COPYPDS  JOB
//COPY     EXEC PGM=IEHMOVE
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD UNIT=SYSDA,SPACE=(TRK,(1,1)),DISP=OLD
//CBMTPE   DD UNIT=TAPE,VOL=(PRIVATE,RETAIN,SER=CBMTPE),DISP=OLD
//CBMDSK   DD UNIT=DISK,VOL=SER=VOLUME,DISP=OLD
//SYSIN    DD *
  COPY PDS=COMBIMAN.LOADLIB,FROM=TAPE=(CBMTPE,2),TO=DISK=VOLUME
/*
//
```

THE JCL TO COPY A SEQUENTIAL DATA SET, COMBIMAN.ANTDATA,
FROM CBMTPE FILE 4 IS:

```
//COPYSEQ  JOB
//COPY     EXEC PGM=IEHMOVE
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD UNIT=SYSDA,SPACE=(TRK,(1,1)),DISP=OLD
//CBMTPE   DD UNIT=TAPE,VOL=(PRIVATE,RETAIN,SER=CBMTPE),DISP=OLD
//CBMDSK   DD UNIT=DISK,VOL=SER=VOLUME,DISP=OLD
//SYSIN    DD *
  COPY DSNAME=COMBIMAN.ANTDATA,FROM=TAPE=(CBMTPE,4),TO=DISK=VOLUME
/*
//
```

APPENDIX B-1

LINKAGE EDITOR MAPS FOR CBM04

```
//CBM04L  JOB  CLRI,OAPU
//LKED  EXEC  PGM=IEWL,REGION=120K,PARM='LET,LIST,MAP,SIZE=(120K,20K)'
//SYSLIB  DD  DSNAME=SYS1.FORTLIB,DISP=SHR
//         DD  DSN=SYS1.LINKLIB,DISP=SHR
//         DD  DSNAME=SYS1.HESSFORT,DISP=SHR
//SYSUT1  DD  UNIT=SYSDA,SPACE=(7294,(20,,20),,,ROUND),
//          DCB=BLKSIZE=7294
//CBMLIB DD DSN=KIKTA.POSTCMP.OBJECT,DISP=SHR
//SYSPRINT  DD  SYSOUT=A
//SYSLMOD  DD  DSN=COMBIMAN.LOADLIB,DISP=OLD
//SYSLIN  DD  DDNAME=SYSIN
//SYSIN  DD  *
//
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED) LET,LIST,MAP,SIZE=(120K,20K)
          VARIABLE OPTIONS USED -  SIZE=(122880,20480)
IEW0000           ENTRY CBMRTS
IEW0000           INCLUDE SYSLIB(IHCOSPCB)
IEW0000           INCLUDE SYSLIB(SYMBOL,LINE,NUMBER,AXIS,SCALE,PLOTS,PLOTSYM,O)
IEW0000           INCLUDE CBMLIB(CBMABC,CBMASM,CBMCP1,CBMCP2,CBMCP3,CBMCP4,CBMCSV,
IEW0000                    CBMDAT,CBMDEP,CBMDSP,CBMENF,CBMENV,CBMERR,CBMFNA,
IEW0000                    CBMIDP,CBMIND,CBMINT,CBMINI,CBMIOI,CBMJCT,CBMPLT,
IEW0000                    CBMPEF,CBMPER,CBMPLT,CBMPRT,CBMPST,CBMRCH,CBMRPT,
IEW0000                    CBMRST,CBMRTS,CBMSSW,CBMTAT,CBMTNG,CBMTRM,CBMTSR,
IEW0000                    CBMVIS,CBMCSR,CBMCST,CBMLPN,CBMZAP,CBMXHR,CBMCNV)
IEW0000       NAME CBM04
```

MODULE MAP

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
IHGSPO3	00	15C								
			INDEV	00	IMDEV	4	INGDS	[illegible]	INGDS	C
			CRATL	10	ENATL	14	ENATN	18	OSATN	1C
			MPATL	20	MCPEU	24	SEPAT	28	MCETS	2C
			RQATN	30	CORATL	34	SETATN	38	SAERN	3C
			GSPRJ	40	RCURS	44	ICURS	48	SOATS	4C
			SGRAM	50	SJATL	54	SGDSL	58	SSETS	5C
			SCHAM	60	PLINE	64	PPNT	68	PSSNT	6C
			PTEXT	70	STPOS	74	MVPOS	78	OOSCA	7C
			RGSOS	80	ENSEQ	84	ENSUB	88	ENSOG	8C
			INCL	90	CMIT	94	EXEC	98	RESET	9C
			IOPOS	A0	FSMOD	A4	STCOS	A8	[illegible]	AC
			LOCPN	B0	BGTRK	B4	NOTEK	B8	ENTER	BC
			OFSTR	C0	PESTR	C4	GROGN	C8	ONVRT	CC
			ITRC	D0	ITBP	D4	RTBP	D8	ITST	DC
			SPEC	E0						
SYMBOL	160	9E0	WIDTHR	56A						
LINE	840	184								
NUMBER	CC8	1A0								
AXIS	EC8	534								
SCALE	13A0	230								
PLTPLOTS	1500	F70	PLOTS	1500	FACTOR	1924	ERASE	[illegible]	[illegible]	[illegible]
			WHERE	1930	LINEWT	19E8	[illegible]	[illegible]	[illegible]	[illegible]
			OFFSET	1A5A	RESRV	[illegible]	PLOTT	[illegible]	PLOT	[illegible]
			GOSERR	2040						
PLTPT48	2540	58C	PLOTOUT	2546	PLTTCUTI	2700				
PLTBITST	2AD0	1B9C	BITSET	2AD0	BITSETE	[illegible]	[illegible]	[illegible]		
P2INR2	4C70	0B0	BITINIT	4C70	BITFORMAT	[illegible]	[illegible]	[illegible]		
CDMACC	5420	1600								

NAME	ORIGIN	LENGTH
CBMASM	6AA0	140A
CBMCP1	7EB0	AFBC
CBMCP2	12E70	7A4
CBMCP3	13618	2648
CBMCP4	15C60	614
CBMCVW	16278	912
CBMDAT	16B90	15C
CBMDEP	16CF0	102E
CBMDSP	17D20	B75E
CBMENF	23480	1002
CBMENV	24558	28C6
RDIST	26E20	19A
DLINE	26FC0	19A
CBMEN1	27160	C8C
CBMGQA	27DF0	378
CBMIDP	28168	B4C
CBMIND	28CB8	2484
CBMINT	28140	1B92
CBMIN1	2CCD8	3B24
CBMIOI	30800	848
CBMJCT	31348	846
CBMMLT	31B90	3FE
CBMPEF	31F90	77E
CBMPFK	32710	26C
CBMPLN	32980	211C
CBMPRT	34AA0	BCA
CBMPST	35670	306
CBMRCH	35978	1F38
CBMRPY	37BB0	6FA
CBMRST	37FB0	3638
CBMRTS	385E8	A2C
CBMSSW	3C018	38C
CBMTKI	3C3D8	174
CBMTNG	3C550	E7C
CBMTRM	3D3D0	384
CBMTSK	3D758	F6
CBMVIS	3D850	AA2E
CBMCSR	48280	313C
CBMCSI	483C0	892
CBMLPN	4BC58	20E
CBMZAP	4BE68	F6
CBMXHR	4BF60	1188
CBMCNV	4D0E8	200
IHCSLOG *	402E8	186
IHCFMAXR*	404A0	C9
IHCSASCN*	40570	1DF
IHCSATN2*	40750	1CB
IHCSSCN *	40920	109

NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
ALOG10	402E8	ALOG	40300				
MAX1	404A0	MIN1	40	AMAX1	40	AMIN1	40
ARCOS	40570	ARSIN	40				
ATAN2	40750	ATAN	407				

NAME	ORIGIN	LENGTH
IHCFRXPR*	4DB00	183
IHCECOMH*	4DC88	F62
IHCCOMF2*	4EBF0	6C1
IHCSSQRT*	4F288	145
IHCEFNTH*	4F400	542
IHCGSPC4*	4F948	2B8
IHCSEXP *	4FC00	192
IHCEFICS*	4FC98	F48
IHCFIOS2*	50CE0	556
IHCFRXFI*	51238	141
IHCERRM *	51380	5DC
IHCUOPT *	51960	308
IHCGSPC2*	51C68	EA
WAITD *	51D58	8C
IHCFCVTH*	51DE8	11B5
IHCEDICS*	52FA0	E6E
IHCGSP01*	53E10	A2
IHCETRCH*	53EB8	28E
IHCUATBL*	54148	638
CBMRGR	54780	505C
CBMREN	597E0	1B4
CBMJC1	59998	1E0
CBMBDM	59B78	1934
CBMDAV	5B530	C
CBMBOS	5B540	1A4
CBMMVE	5B6E8	10
CBMGRA	5B6F8	88
CBMPDT	5B780	20
CBMXYZ	5B7A0	6500
CBMBXY	61CA0	4100
CBMVEW	65DA0	C8
LBMETN	65E68	40
CBMRCA	65EA8	AD8

ENTRY ADDRESS 3B5E8
TOTAL LENGTH 66980

****C9M04 NOW ADDED TO DATA SET

NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
COS	40920	SIN	40958				
FRXPR#	4DB00						
IBCOM#	40C88	FDIOCS#	40D44	INTSWTCH	4F8CC		
SEQDA3D	4EFCC						
SQRT	4F288						
ARITH#	4F400	ADJSWTCH	4F79C				
BCNV	4F948						
EXP	4FC00						
FIOCS#	4FD98	FIOCSOTP	4FD9E				
FRXPI#	51238						
ERRMON	51380	IHCERRF	51398				
IMGSP	51C68						
ADCON#	51DE8	FCVADOTP	51E92	FCVEOUTP	51F22	FCVZOUTP	52026
FCVIOUTP	52430	FCVEOUTP	52932	FCVCOUTP	52940	INTOSWCH	52E33
DIOCS#	52FA0						
INGSP	53E10						
IHCTRCH	53EB8	ERRTRA	53EC0				

APPENDIX B-2

LINKAGE EDITOR MAP OF CBMAM

```
//CBMAMLD JOB BARD,DDLI
//LKED    EXEC  PGM=IEWL,PARM='LET,LIST,MAP'
//SYSLIB   DD    DSNAME=SYS1.FORTLIB,DISP=SHR
//CBMLIB DD DSN=ANITA.PGSTEMP.OBJECT,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSLMOD  DD    DSNAME=CBM.SIMAM.LOADLIB,DISP=OLD
//SYSUT1 DD UNIT=SYSDA,SPACE=(1024,(200,200))
//SYSLIN   DD    *
//
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LET,LIST,MAP
        DEFAULT OPTION(S) USED -  SIZE=(92160,8192)
IEW0000             INCLUDE CBMLIB(CBMADM,CBMADP,CBMDAT)
IEW0000            NAME  CBMAM
```

MODULE MAP

CONTROL SECTION

NAME	ORIGIN	LENGTH
CBMADM	00	6468
CBMADP	6468	25C
CBMDAT	66C8	15C
IHCEDICS*	6828	E6E
IHCECOMH*	7698	F62
IHCCOMB2*	8600	6C1
IHCFCVTH*	8CC8	11E5
IHCEFNTH*	9E80	542
IHCEFICS*	A3C8	F48
IHCFIOS2*	B310	556
IHCERRM *	B868	5CC
IHCUATBL*	BE40	638
IHCUOPT *	C480	308
IHCETRCH*	C788	28E
CBMADC	CA16	20

ENTRY

NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
DIOCS#	6828						
IBCOM#	7698	FDIOCS#	7754	INTSWTCH	85DE		
SEQDASD	890C						
ADCON#	8CC8	FCVAOUTP	8D72	FCVIOUTP	8E02	FCVZOUTP	8F9C
FCV1OUTP	9310	FCVEOUTP	9812	FCVCOUTP	9920	INTOSWCH	9D1C
ARITH#	9E80	ADJSWTCH	A21C				
FIOCS#	A3C8	FIOCS0EP	A3CE				
ERRMON	B868	IHCERRE*	B880				
IHCTRCH*	C788	ERRTRA	C790				

```
ENTRY ADDRESS        00
TOTAL LENGTH       CA38

****CBMAP      NOW ADDED TO DATA SET
```

APPENDIX B-3

LINKAGE EDITOR MAP FOR CBMCM

```
//CBMCMLD JOB BAPU,UDRI
//LKED      EXEC  PGM=IEWL,PARM=(LET,LIST,MAP)
//SYSLIB    DD     DSNAME=SYS1.FORTLIB,DISP=SHR
//CBMLIB DD DSN=KIKTA.POSTCMP.OBJECT,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSLMOD  DD     DSNAME=COMBIMAN.LOADLIB,DISP=OLD
//SYSUT1 DD UNIT=SYSDA,SPACE=(1024,(200,200))
//SYSLIN    DD     *
//


 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LET,LIST,MAP
         DEFAULT OPTION(S) USED -   SIZE=(92160,6192)
IEW0000              INCLUDE CBMLIB(CBMCDM,CBMCDP,CBMDAT,CBMDT3,CBMDT4,CBMTRN)
IEW0000              NAME  CBMCM

                                         MODULE MAP

 CONTROL SECTION                      ENTRY

   NAME     ORIGIN  LENGTH              NAME    LOCATION     NAME    LOCATION     NAME    LOCATION     NAME    LOCATION

 CBMCDM        00    10358
 CBMCDP     10358     24C
 CBMDAT     105A8     15C
 CBMDT3     10708     224
 CBMDT4     10930     494
 CBMTRN     10CC8     29C
 IHCEDICS*  11068     E6E
                                      DICCS#     11068
 IHCECOMH*  11ED8     F62
                                      IBCOM#     11ED6     FDIOCS#    11F94     INTSWTCH   12EEC
 IHCCOMH2*  12E40     6C1
                                      SEQDASD    1321C
 IHCSSQRT*  13508     145
                                      SQRT       13508
 IHCFCVTH*  13650    1185
                                      ADCON#     13650     FCVAOUTP   136EA     FCVLOUTP   1378A     FCVZOUTP   138E4
                                      FCVIOUTP   13C98     FCVEOUTP   1419A     FCVCOUTP   14384     INT6SWCH   14590
 IHCEFNTH*  14808     542
                                      ARITH#     14808     ADJSWTCH   14BA4
 IHCEFIOS*  14D50     F48
                                      FIOCS#     14D50     FIOCSBEP   14D57
 IHCFIOS2*  15C98     556
 IHCERRM *  161F0     5DC
                                      ERRMON     161F0     IHCERRE    1620B
 IHCUATBL*  16700     638
 IHCUOPT *  16E08     308
 IHCETRCH*  17110     28E
                                      IHCTRCH    17110     ERRTRA     17116
 CBMWDC     173A0      20

ENTRY ADDRESS        00
TOTAL LENGTH      173C0

****CBMCM     NOW ADDED TO DATA SET
```

APPENDIX B-4

LINKAGE EDITOR MAP OF CBMVM

```
//CBMVMLD JOB 8APU,UDRI
//LKED      EXEC  PGM=IEWL,PARM=(LET,LIST,MAP)
//SYSLIB    DD    DSNAME=SYS1.FORTLIB,DISP=SHR
//CBMLIB DD DSN=KIKTA.POSTCMP.OBJECT,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSLMOD  DD    DSNAME=CCMJIMAN.LOADLIB,DISP=OLD
//SYSUT1 DD UNIT=SYSDA,SPACE=(1024,(200,200))
//SYSLIN   DD    *
//


F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LET,LIST,MAP
          DEFAULT OPTION(S) USED -   SIZE=(92160,81921)
IEW0000                INCLUDE CBMLIB(CBMVDM,CBMVCP,CBMDAT)
IEW0000            NAME   CBMVM

                                                   MODULE MAP

 CONTROL SECTION                        ENTRY

   NAME      ORIGIN  LENGTH               NAME    LOCATION    NAME     LOCATION    NAME     LOCATION    NAME     LOCATION

 CBMVDM         00    7EE4
 CBMVDP       7EE8     27C
 CBMDAT       8158     15C
 IHCEDICS*    8288     E6E               DIOCS#      8288
 IHCECCMH*    9128     F62               IBCOM#      9128     FDIOCS#    91E4      INTSWTCH    A06C
 IHCCOMH2*    A090     6C1               SEQDASD     A46C
 IHCFCVTH*    A758    1185               ADCON#      A758     FCVAOUTP   A802      FCVEOUTP    A0[illegible]  FCVZOUTP  A9[illegible]
                                         FCVIOUTP    ADAO     FCVLOUTP   B2A2      FCVCOUTP    [illegible]    INTFSWCH  [illegible]
 IHCEFNTH*    B910     542               ARITH#      B910     ADJSWTCH   BCAC
 IHCEFICS*    BE58     F48               FIOCS#      BE58     FIOCSBEP   BE5E
 IHCFIOS2*    CDA0     556
 IHCERRM *    D2F8     50C               ERRMON      D2F8     IHCERRE    D310
 IHCUATBL*    D808     634
 IHCUOPT *    DF10     3?8
 IHCETRCH*    E218     28F               IHCTRCH     E218     ERRTRA     E220
 CBMVDC       E4A8      2C

ENTRY ADDRESS       00
TOTAL LENGTH      E4D8

****CBMVM     NOW ADDED TO DATA SET
```

APPENDIX C-1

COMBIMAN SOURCE

CBMCP2 LISTING

```
      SUBROUTINE CBMCP2(X,Y)
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     CBMCP2 - PLOTS MAN-MODEL AND CREW STATION ON GOULD PLOTTER
C
C        CALLED BY -
C             CBMCP1 - MAIN COMBIMAN PLOT ROUTINE
C             CBMCP4 - HEADING PLOT ROUTINE
C
C        CALLS -
C             PLOT   - CALCOMP ROUTINE (DRAW LINE)
C             SYMBOL - GOULD CHARACTER PLOT ROUTINE
C
C        OUTPUT TO -
C             UNIT  9 - PLOTTER DATA
C
C        PARAMETERS -
C             X - ARRAY OF X VALUES TO BE PLOTTED
C             Y - ARRAY OF Y VALUES TO BE PLOTTED
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C        COMMON  // CBMBXY //  MAN-MODEL XYZ DATA
C             PROJECTED ENFLESHMENT ELLIPSOID SURFACE POINTS - XYZ.
C             INDEX ARRAY TO DEFINE RELATIONSHIP BETWEEN POINTS AND
C             LINKS.
C             INDEX ARRAY TO XYZ'S TO LOCATE TANGENT LINE ENDPOINTS.
C
      INTEGER XYZK
      COMMON /CBMBXY/ XYZEN(3,1000),XYZK(1000),NTAN(2,40),
     1        MAXTAN(2,40)
C
C        COMMON  // CBMXYZ //  MAN-MODEL AND WORKSPACE XYZ DATA
C             MAN-MODEL JOINT AND ELLIPSE CENTERS (NEUTRAL AND
C             PROJECTED).
C             WORKSPACE PANEL XYZ DATA.
C             KEY TO WXYZ ARRAY - IDENTIFYING EACH POINT WITH A PANEL.
C             MAX NUMBER OF XYZ'S, WORKSPACE-XYZ'S, KEYS, CONTROL
C             POINTS ALLOWED.
C             NUMBER OF LINKS, KEYS, XYZ'S, LINK-XYZ'S, WORKSPACE-
C             XYZ'S, CONTROLS, AND DIMENSIONS.
C             KEYTAB BOOKKEEPING ARRAY.
C             CONTROL POINT DATA.
C             STATE SWITCH ARRAY.
C
      INTEGER WXYZK,CTLTYP,CTLPNL,CTLPNT,BLANK,CTLNAM
      COMMON /CBMXYZ/ XYZC(3,40,2),XYZ(3,40),WXYZ(3,150),WXYZK(150),
     1        MAXXYZ,MAXW,MAXKEY,MAXCTL,NWK,NBOXES,NLINKS,NCPS(2),NBOX(2),
     2        ISKYY(2),MSGY(2),IWKSP(2),NBOXES(2),IIASK(2),
     3        KEYTAB(6,250),CTLNAM(2,150),
     4        CTLTYP(150),CTLXYZ(5,150),CTLPNL(150),CTLPNT(150),
     5        BLANK,ISW(3),WKEY,WXYZ,NDIM,BLANK2,WXYZ,WCTL,IWSP,
     6        ISW(72)
C
      DIMENSION X(1),Y(1)
      INTEGER BLANK,ITEXT(10)
      EQUIVALENCE (ITEXT,BLANK,BLANK3(7))
C
```

```
C           PLOT MAN-MODEL LINKS AND WORKSTATION
C
      J=IABS(KEYTAB(3,1))
      HIER(J)=1
      CALL PLOT(X(1),Y(1),3)
C
      DO 50 I=2,NLNKS
       J=IABS(KEYTAB(5,I))
       K=KEYTAB(1,I)
       HIER(J) = I
C
C          DISPLAY ONLY HEAD AND NECK LINKS IF ISW(5)=0 (OFF)
C
       IF((ISW(3).EQ.0.AND.(I.LE.5.OR.I.GE.11)).AND.ISW(5).EQ.0)
     *      GO TO 20
C
C          LOCATE COORDINATE OF PREVIOUS POINT IN THE CHAIN
C
       L = HIER(J-1)
       CALL PLOT(X(L),Y(L),3)
   10  M=2
C
C          CHECK IF OMIT OR INCLUDE STATUS
C
       IF (KEYTAB(5,I).LT.0.AND.KEYTAB(6,I).LT.0) M=3
       CALL PLOT(X(I),Y(I),M)
   20  J=IABS(KEYTAB(6,I))
       IF (J.EQ.1) GO TO 50
C
C          PLOT ENFLESHED MAN-MODEL
C
   30  KP=KEYTAB(1,I)+NLNKS-1
       L1=KP+KEYTAB(5,I)-2
C
   35  DO 45 L2=KP,L1
        CALL SYMBOL(X(L2)-.04,Y(L2),.175,14,0.0,1,.175,3)
   45  CONTINUE
C
       IF(MINTAN(1,I).EQ.0) GO TO 50
       L1=MINTAN(1,I)+NLNKS
       L2=MINTAN(2,I)+NLNKS
       CALL PLOT(X(L1),Y(L1),3)
       CALL PLOT(X(L2),Y(L2),2)
       L1=MAXTAN(1,I)+NLNKS
       L2=MAXTAN(2,I)+NLNKS
       CALL PLOT(X(L1),Y(L1),3)
       CALL PLOT(X(L2),Y(L2),2)
   50 CONTINUE
C
C          PLOT WORKSTATION PANELS
C
      IF (NLNKS.EQ.NKEY) RETURN
      L1=NLNKS+1
C
      DO 80 I=L1,NKEY
       K=KEYTAB(1,I)+MAXZ+NLNKS
       CALL PLOT(X(K),Y(K),3)
       M=2
       IF (KEYTAB(5,I).LT.0.AND.KEYTAB(6,I).LT.0)
```

```
      J=IABS(KEYTAB(6,I))                                          00012 00
      L=K+1                                                        00012900
      K=K+J-1                                                      00013000
C                                                                  00013100
      DO 60 J=L,K                                                  00013200
   60 CALL PLOT(X(J),Y(J),4)                                       00013300
C                                                                  00013400
   80 CONTINUE                                                     00013500
C                                                                  00013600
      RETURN                                                       00013700
      END                                                          00013800
```

APPENDIX C-2

COMBIMAN SOURCE

CBMCP3 LISTING

```
      SUBROUTINE CBMCP3(DX,DY,SCLE,XZD1,XZD3,IEC,IPERSP)
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     CBMCP3 - WRITES COMBIMAN DATA FOR OFF-LINE PLOT ON UNIT 11
C
C        CALLED BY -
C             CBMCP1 - MAIN COMBIMAN PLOT ROUTINE
C
C        OUTPUT TO -
C             UNIT 11
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
      INTEGER IDX(2000)
      REAL DX(1),DY(1)
C
COPY,S CBMBXY
COPY,S CBMVEW
COPY,S CBMXYZ
C
      INTEGER PVIEW
      IEC=0
      PVIEW=OMEGA(1,2)+OMEGA(2,3)+2
      TEMP=ABS(ROLL)+ABS(PITCH)+ABS(YAW)
      IF(TEMP.NE.0.)PVIEW=4
      N=ISW(13)
C                              PLOT NUMBER
      MAXD=NXYZ+NWXYZ+NLNKS
      WRITE(11,10) MAXD,NWXYZ,NKEY,NLNKS,NXYZ,SCLE,XZD1,XZD3,N,IPERSP
C
      DO 20 I=1,MAXD
   20 IDX(I)=DX(I)*100.
C
        WRITE (11,30) (IDX(I),I=1,MAXD)
C
      DO 25 I=1,MAXD
   25 IDX(I)=DY(I)*100.
C
      WRITE ( 11,30) (IDX(I),I=1,MAXD)
      WRITE(11,30) (KEYTAB(1,I),I=1,NKEY)
      WRITE(11,30) (KEYTAB(5,I),I=1,NKEY)
      WRITE(11,30) (KEYTAB(6,I),I=1,NKEY)
C
      DO 50 I=1,2
      WRITE(11,40) ((MINTAN(I,J),J=1,NLNKS))
      WRITE(11,40) (MAXTAN(I,J),J=1,NLNKS)
50    CONTINUE
C
      WRITE(11,60) IRSAV,ISAVY,IWKSP
      WRITE(11,65) PVIEW,ROLL,PITCH,YAW
   65 FORMAT(I2,3F10.2)
      WRITE (11,70)
      RETURN
C
C        FORMATS
C
   10 FORMAT(I4,2I3,I2,I4,F4.2,2F7.2,2I2)
30    FORMAT(16I5)
40    FORMAT(20I4)
60    FORMAT(20A4)
   70 FORMAT (4H-999)
C
      END
```

APPENDIX C-3

COMBIMAN SOURCE

CBMCP4 LISTING

```
      SUBROUTINE CBMCP4(DX,DY,SCLE,IPERSP)                                  00001000
C                                                                           00001100
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *   00001200
C                                                                           00001300
C     CBMCP4 - PLOTS HEADINGS AND DEFINES BOUNDARIES FOR                    00001400
C              PLOTS OF MAN MODEL AND CREW STATION ON                       00001500
C              GOULD PLOTTER (INTERMEDIATE ROUTINE)                         00001600
C                                                                           00001700
C        CALLED BY -                                                        00001800
C             CBMCP1 - MAIN CONBIMAN PLOT ROUTINE                           00001900
C                                                                           00002000
C        CALLS -                                                            00002100
C             CBMCP2 - PLOTS MAN-MODEL AND CREW STATION ON GOULD            00002200
C             CLSOUT - FREE BUFFER (GOULD)                                  00002300
C             NUMBER - PLOT NUMBER (GOULD)                                  00002400
C             PLOT   - GENERAL PLOT (GOULD)                                 00002500
C             PLOTS  - INITIALIZE PLOTTER (GOULD)                           00002600
C             SYMBOL - PLOT SYMBOL (GOULD)                                  00002700
C                                                                           00002800
C        OUTPUT TO -                                                        00002900
C             SYSPLOT - GOULD PLOTTER                                       00003000
C                                                                           00003100
C        PARAMETERS -                                                       00003200
C             DX(3000) ARRAY OF SCALED X COORDINATES                        00003300
C             DY(3000) ARRAY OF SCALED Y COORDINATES                        00003400
C             SCLE - PLOT SCALE FACTOR                                      00003500
C             IX - REAL WORLD COORD. ALIGNED WITH X SCREEN COORD.           00003600
C             IY - REAL WORLD COORD. ALIGNED WITH Y SCREEN COORD.           00003700
C                                                                           00003800
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *   00003900
C                                                                           00004000
      DIMENSION XZD(3),DX(1),DY(1)                                          00004100
      INTEGER MSG(3),IVIEW(5),MSG1(5),BLANK                                 00004200
C                                                                           00004300
COPY,S CBMBXY                                                               00004400
COPY,S CBMVEW                                                               00004500
COPY,S CBMXYZ                                                               00004600
C                                                                           00004700
      EQUIVALENCE (XZD(1),XD)                                               00004800
      EQUIVALENCE (BLANK,BLANKS(1))                                         00004900
C                                                                           00005000
      DATA IVIEW/'XY  ','XZ  ','YZ  ','OFF ','AXIS'/                        00005100
      DATA MSG/4HVIEW,4H=PLA,4HNE: /                                        00005200
      DATA MSG1/4HROLL,4H   P,4HITCH,4H    ,4HYAW /                         00005300
      NCH=4                                                                 00005400
C                              NUMBER OF CHARACTERS TO BE DISPLAYED         00005500
      PVIEW=OMEGA(1,2)+OMEGA(2,3)+2                                         00005600
      TEMP = ABS(ROLL) + ABS(PITCH) + ABS(YAW)                              00005700
      IF(TEMP.NE.0) PVIEW=4                                                 00005800
      IF(PVIEW.EQ.4) NCH=8                                                  00005900
C                                                                           00006000
C        PLOT TITLE                                                         00006100
C                                                                           00006200
      CALL PLOTS(5.,10.)                                                    00006300
C                              SIZE OF PLOT                                 00006400
      CALL SYMBOL(1.,1.75,.25,MSGX1(1),90.,16,.25,0)                        00006500
C                              REGRESSION MEMBER                            00006600
      CALL SYMBOL(1.5,1.75,.25,MSGX(1),90.,16,.25,0)                        00006700
C                              SURVEY MEMBER                                00006800
```

```
      CALL SYMBOL(2.0,2.,.25,MSGY(1),90.,16,.25,0)                      00006900
C                              CREW STATION MEMBER                      00007000
      CALL SYMBOL(2.5,1.,.25,MSG(1),90.,12,.25,0)                       00007100
C                              VIEW PLANE:                              00007200
      CALL SYMBOL(999.,999.,.25,IVIEW(PVIEW),90.,NCH,.25,0)             00007300
C                              VIEW XY, XZ, YZ OR OFF AXIS              00007400
      CALL SYMBOL(3.0,1.5,.25,MSG(1),90.,20,.25,0)                      00007500
C                              ROLL, PITCH, AND YAW                     00007600
      CALL NUMBER(3.5,2.25,.25,ROLL,90.,1,2)                            00007700
C                              ROLL ANGLE IN DEGREES                    00007800
      CALL NUMBER(3.5,4.25,.25,PITCH,90.,1,2)                           00007900
C                              PITCH ANGLE IN DEGREES                   00008000
      CALL NUMBER(3.5,6.5,.25,YAW,90.,1,2)                              00008100
C                              YAW ANGLE IN DEGREES                     00008200
      IF (IPERSP.EQ.1) CALL SYMBOL(4.,1.75,.25,15HNON-PERSPECTIVE,      00008300
     *          90.,15)                                                00008400
      IF (IPERSP.EQ.2) CALL SYMBOL(4.,2.25,.25,11HPERSPECTIVE,          00008500
     *          90.,11)                                                00008600
      CALL SYMBOL(4.5,2.25,.25,6HSCALE=,90.,6)                          00008700
      CALL NUMBER(999.,999.,.25,SCLE,90.,2)                             00008800
C                              SCALE                                    00008900
      CALL PLOT(0.,0.,999)                                              00009000
C                              TERMINATE TITLE PLOT                     00009100
      CALL PLOTS(-60.,-60.)                                             00009200
C                              START COMBIMAN PLOT                      00009300
      CALL CBMCP2(DX(1),DY(1))                                          00009400
C                              PLOT MAN-MODEL AND CREW STATION          00009500
      CALL PLOT(0.,0.,999)                                              00009600
C                              TERMINATE COMBIMAN PLOT                  00009700
      CALL CLSOUT                                                       00009800
C                              CLOSE FILE AND FREE CORE                 00009900
      RETURN                                                            00010000
      END                                                               00010100
```

APPENDIX C-4

CBMOFF LISTING

```
C                                                                       00001000
C   CBMOFF- TAKES DATA OFF OF TAPE TO BE USED TO PLOT COMBIMAN--OFFLINE  00001100
C                                                                       00001200
C                                                                       00001300
C        CALLS -                                                        00001400
C             PLOTS  - CALCOMP ROUTINE (PLOT INITIALIZATION)            00001500
C             PLOT   - CALCOMP ROUTINE (DRAW LINE OR POSITION THE PEN)  00001600
C             NEWPEN - CALCOMP ROUTINE (CHANGE THE PEN COLOR)           00001700
C             FACTR  - CALCOMP ROUTINE (RESET PLOT SCALE FACTOR)        00001800
C             SYMBOL - CALCOMP ROUTINE (DRAW A SYMBOL, CHARACTER, OR A  00001900
C                      CHARACTER STRING)                                00002000
C             NUMBER - CALCOMP ROUTINE (DRAW A NUMBER)                  00002100
C             CBMCP2 - PLOT THE MAN MODEL AND CREW STATION              00002200
C             PLOTE  - CALCOMP ROUTINE (CLOSE THE PLOT FILE)            00002300
C                                                                       00002400
C        INPUT FROM -                                                   00002500
C             UNIT 5 - CARD INPUT                                       00002600
C             UNIT 8 - PLOT DATA ON DISK OR MAGNETIC TAPE OR CARDS      00002700
C                                                                       00002800
C        OUTPUT TO -                                                    00002900
C             UNIT 6 - PRINTER                                          00003000
C             UNIT 7 - PLOT TAPE                                        00003100
C                                                                       00003200
C                                                                       00003300
      REAL DX(2000),DY(2000)                                            00003400
      COMMON/DUMMY/ MSGX1(2),IRSRV(2),MSGX(2),ISRVY(2),MSGY(2),IWKSP(2) 00003500
      DIMENSION IPLOT(20),DATA(1924)                                    00003600
      COMMON/CBMXYZ/ KEYTAB(3,250),NLNKS,MINTAN(2,40),MAXTAN(2,40),     00003700
     1    NKEY,NXYZ,ICOLOR(4),FLESH,FACTR,SCLE                          00003800
C                                                                       00003900
C***  THE INPUT STREAM CONSISTS OF                                      00004000
C          1. THE NAMELIST "CNTRL", EVEN IF IT'S EMPTY                  00004100
C          2. A CARD WITH THE NUMBERS OF THE PLOTS NOT WANTED           00004200
C                                                                       00004300
C          ALSO;THE PLOT DATA FILE SHOULD BE ATTACHED TO THE PROGRAM AS 00004400
C             UNIT 8.                                                   00004500
C                                                                       00004600
C  THE NAMELIST VARIABLES AND THEIR DEFAULT VALUES                      00004700
C  1...FACTR- SCALE FACTOR FOR PLOT (DEFAULT=THAT SPECIFIED DURING      00004800
C             CBM04 RUN)                                                00004900
C   2...LINKS- 0, IF LINK SYSTEM IS TO BE PLOTTED; 1, IF NOT (DEF=0)    00005000
C    3...FLESH- 0, IF ENFLESHMENT ELIPSOIDS ARE TO BE PLOTTED; 1, IF    00005100
C         NOT (DEF=0)                                                   00005200
C     4...CRST- 0, IF CREW STATION IS TO BE PLOTTED; 1, IF NOT (DEF=0)  00005300
C      5...(ICOLOR(I), I=1,4)- PEN COLORS FOR BANNER, LINK SYSTEM,      00005400
C          ENFLESHMENT ELIPSOIDS, AND CREW STATION RESPECTIVELY         00005500
C          (DEF=1, 1, 2, 3)                                             00005600
C                                                                       00005700
      DIMENSION MSG1(3),MSG2(3),MSG3(3),MSG4(3),MSG5(6),IVIEW(5)        00005800
      INTEGER FLESH,CRST,PVIEW                                          00005900
      NAMELIST /CNTRL/ FACTR,LINKS,FLESH,CRST,ICOLOR                    00006000
      DATA FACTR,LINKS,FLESH,CRST/99.,3*0/                              00006100
      DATA  END/4H-999/,IPCNT/0/                                        00006200
      DATA MSG1/4H     ,4HREGR,4HESS1/, MSG2/4H     ,4H SUR,4HVEY1/,    00006300
     1     MSG3/4H     ,4H   C,4HRST1/, MSG4/4H VIE,4HW-PL,4HANE1/,     00006400
     2     MSG5/3H  R,4HOLL ,4H  PI,4HTCH ,4H   Y,4HAW  /               00006500
      DATA IVIEW/4HXY  ,4HXZ  ,4HYZ  ,4HOFF ,4HAXIS/                    00006600
```

```
      ICOLOR(1)=1                                                       00006700
      ICOLOR(2)=1                                                       00006800
      ICOLOR(3)=2                                                       00006900
      ICOLOR(4)=3                                                       00007000
      READ(5,CNTRL)                                                     00007100
      WRITE(6,CNTRL)                                                    00007200
C                                                                       00007300
C   READ IN PLOT NUMBERS FOR THOSE NOT WANTED(IN ANY ORDER)             00007400
      READ(5,80) (IPLOT(I),I=1,20)                                      00007500
   80 FORMAT(20(1X,I2))                                                 00007600
C                                                                       00007700
C                                                                       00007800
C   PLOT INITIALIZATION FOR OFFLINE CALCOMP PLOT                        00007900
      CALL PLOTS(DATA,1024,7)                                           00008000
C                                                                       00008100
C                                                                       00008200
C   MOVE THE PEN TO THE -Y LIMIT SWITCH(PEN PLOTTER ONLY)               00008300
      CALL PLOT(0.,-2.,-3)                                              00008400
C                                                                       00008500
C                                                                       00008600
C   SET THE MARGIN                                                      00008700
      CALL PLOT(1.,1.,-3)                                               00008800
C                                                                       00008900
      IPC=0                                                             00009000
C                                                                       00009100
C***  ROUTINE TO CHECK IF PLOT IS WANTED                                00009200
C                                                                       00009300
    5 IPCNT=IPCNT+1                                                     00009400
      DO 145 ICHECK=1,20                                                00009500
      IF(IPCNT .NE. IPLOT(ICHECK)) GO TO 145                            00009600
C     SKIP PLOT DATA SUBFILE                                            00009700
  140 READ(8,99) DATA01                                                 00009800
      IF(EOF(8))130,141                                                 00009900
  141 IF(DATA01 .NE. END) GO TO 140                                     00010000
      WRITE(6,150) IPCNT                                                00010100
  150 FORMAT(1X,9HPLOT SET ,I2,28H WAS NOT PLOTTED--BY REQUEST)         00010200
      GO TO 5                                                           00010300
  145 CONTINUE                                                          00010400
      IPC=IPC+1                                                         00010500
C                                                                       00010600
C***  ROUTINE FOR READING DATA OFF TAPE                                 00010700
C                                                                       00010800
      READ(8,10)MAXD,NWXYZ,NKEY,NLNKS,NXYZ,SCLE,XD,YD,N,IPERSP          00010900
      IF(EOF(8))130,12                                                  00011000
   10 FORMAT(I4,2I3,I2,I4,F4.2,2F7.2,2I2)                               00011100
   12 READ(8,30) (DX(I),I=1,MAXD)                                       00011200
      READ(8,30) (DY(I),I=1,MAXD)                                       00011300
   30 FORMAT(16F5.2)                                                    00011400
      READ(8,35) (KEYTAB(1,I),I=1,NKEY)                                 00011500
      READ(8,35) (KEYTAB(2,I),I=1,NKEY)                                 00011600
      READ(8,35) (KEYTAB(3,I),I=1,NKEY)                                 00011700
   35 FORMAT(16I5)                                                      00011800
      DO 50 I=1,2                                                       00011900
      READ(8,40)  (MINTAN(I,J),J=1,NLNKS)                               00012000
      READ(8,40)  (MAXTAN(I,J),J=1,NLNKS)                               00012100
```

```
   40 FORMAT(20I4)                                                      00012200
   50 CONTINUE                                                          00012300
      READ(8,60) IRSRV(1),IRSRV(2),ISRVY(1),ISRVY(2),IWKSP(1),IWKSP(2)  00012400
   60 FORMAT(20A4)                                                      00012500
      READ(8,65) PVIEW,ROLL,PITCH,YAW                                   00012600
   65 FORMAT(I2,3F10.2)                                                 00012700
      READ(8,90) ENDFLE                                                 00012800
   90 FORMAT(A4)                                                        00012900
      IF(ENDFLE .EQ.  END) GO TO 151                                    00013000
      WRITE(6,110)    N                                                 00013100
  110 FORMAT(1X,33HINCORRECT AMOUNT OF DATA FOR PLOT,I2,                 00013200
     -17H --PROGRAM ENDING)                                             00013300
      STOP                                                              00013400
C                                                                       00013500
C***  PLOTTING ROUTINE                                                  00013600
C                                                                       00013700
  151 CONTINUE                                                          00013800
C                                                                       00013900
C   SPECIFY COLOR FOR THE BANNER                                        00014000
      CALL NEWPEN(ICOLOR(1))                                            00014100
C                                                                       00014200
C   PLOT THE BANNER                                                     00014300
C                                                                       00014400
C                              REGRESSION MEMBER                        00014500
      CALL SYMBOL(1.,1.25,.35,MSG1(1),90.,4)                            00014600
      CALL SYMBOL(999.,999.,.35,MSG1(2),90.,4)                          00014700
      CALL SYMBOL(999.,999.,.35,MSG1(3),90.,4)                          00014800
      CALL SYMBOL(999.,999.,.35,IRSRV(1),90.,4)                         00014900
      CALL SYMBOL(999.,999.,.35,IRSRV(2),90.,4)                         00015000
C                                                                       00015100
C                              SURVEY MEMBER                            00015200
      CALL SYMBOL (1.5,1.25,.35,MSG2(1),90.,4)                          00015300
      CALL SYMBOL (999.,999.,.35,MSG2(2),90.,4)                         00015400
      CALL SYMBOL(999.,999.,.35,MSG2(3),90.,4)                          00015500
      CALL SYMBOL (999.,999.,.35,ISRVY(1),90.,4)                        00015600
      CALL SYMBOL (999.,999.,.35,ISRVY(2),90.,4)                        00015700
C                                                                       00015800
C                              CREW STATION MEMBER                      00015900
      CALL SYMBOL (2.,1.25,.35,MSG3(1),90.,4)                           00016000
      CALL SYMBOL (999.,999.,.35,MSG3(2),90.,4)                         00016100
      CALL SYMBOL (999.,999.,.35,MSG3(3),90.,4)                         00016200
      CALL SYMBOL (999.,999.,.35,IWKSP(1),90.,4)                        00016300
      CALL SYMBOL (999.,999.,.35,IWKSP(2),90.,4)                        00016400
C                                                                       00016500
C                              VIEW PLANE:                              00016600
      CALL SYMBOL(2.5,1.25,.35,MSG4(1),90.,4)                           00016700
      CALL SYMBOL (999.,999.,.35,MSG4(2),90.,4)                         00016800
      CALL SYMBOL (999.,999.,.35,MSG4(3),90.,4)                         00016900
C                                                                       00017000
C                              VIEW XY, XZ, YZ, OR OFF AXIS             00017100
      CALL SYMBOL(999.,999.,.35,IVIEW(PVIEW),90.,4)                     00017200
      IF(PVIEW.EQ.4)CALL SYMBOL(999.,999.,.35,IVIEW(5),90.,4)           00017300
C                                                                       00017400
```

```
C                              ROLL, PITCH, AND YAW
      CALL SYMBOL(3.0,1.25,.35,MSG5(1),90.,3)
      DO 155 I=2,6
  155 CALL SYMBOL(999.,999.,.35,MSG5(I),90.,4)
C
C                              ROLL ANGLE IN DEGREES
      YINC=0.
      IF(ABS(ROLL).GE.10.)  YINC=.175
      IF(ABS(ROLL).GE.100.)YINC=.35
      IF(ROLL.LT.0.)YINC=YINC+.175
      CALL NUMBER(3.5,2.12-YINC,.35,ROLL,90.,1)
C
C                              PITCH ANGLE IN DEGREES
      YINC=0.
      IF(ABS(PITCH).GE.10.)  YINC=.175
      IF(ABS(PITCH).GE.100.)YINC=.35
      IF(PITCH.LT.0.)YINC=YINC+.175
      CALL NUMBER(3.5,4.75-YINC,.35,PITCH,90.,1)
C
C                              YAW ANGLE IN DEGREES
      YINC=0.
      IF(ABS(YAW).GE.10.) YINC=.175
      IF(ABS(YAW).GE.100.)YINC=.35
      IF(YAW.LT.0.)YINC=YINC-.175
      CALL NUMBER(3.5,7.55-YINC,.35,YAW,90.,1)
C
C                              PERSPECTIVE OR NON-PERSPECTIVE
      IF(IPERSP.EQ.1)CALL SYMBOL(4.,2.65,.35,15HNON-PERSPECTIVE,90.,15)
      IF(IPERSP.EQ.2)CALL SYMBOL(4.,3.35,.35,11HPERSPECTIVE,90.,11)
C
C                              SCALE
      IF(FACTR.NE.99.)  SCLE=FACTR
      CALL SYMBOL(4.5,3.35,.35,6HSCALE=,90.,6)
      CALL NUMBER(999.,999.,.35,SCLE,90.,2)
C
C                              PLOT NUMBER
      PLT=N
      CALL SYMBOL(5.0,3.7,.35,5HPLOT=,90.,5)
      CALL NUMBER(999.,999.,.35,PLT,90.,-1)
C
C
C   RESET ORIGIN
      CALL PLOT(7.,0.,-3)
C
C
C   GO TO MAN-MODEL AND CREW STATION PLOT ROUTINE
      CALL CBMCP2(DX(1),DY(1))
C
      CALL FACTOR(1.0)
      CALL PLOT(12.,0.,-3)
      GO TO 5
C
C   PLOTE CLOSES OUT THE PLOT
  131 CALL PLOTE(AA)
C
      STOP
      END
```

```
C
C     CBMCP2 - CALCOMP PLOT OF COMBIMAN SECOND SUBROUTINE--ADJUSTED
C                FOR PLOTTING OFFLINE.
C
C        CALLED BY -
C             CBMOFF - CALCOMP (R) PLOT OF COMBIMAN MAIN S/R
C
C        CALLS -
C             PLOT   - CALCOMP ROUTINE (DRAW LINE OR POSITION THE PEN)
C             SYMBOL - CALCOMP ROUTINE(DRAW A SYMBOL, CHARACTER, OR
C            CHARACTER STRING)
C             NEWPEN - CALCOMP ROUTINE (CHANGE THE PEN COLOR)
C
C        INPUT FROM -
C             (NONE)
C
C        OUTPUT TO -
C             UNIT  7 - PLOTTER DATA
C
C        PARAMETERS -
C             X - ARRAY OF X VALUES TO BE PLOTTED
C             Y - ARRAY OF Y VALUES TO BE PLOTTED
C
C
      SUBROUTINE CBMCP2(X,Y)
      REAL X(1),Y(1)
      COMMON/CBMXYZ/ KEYTAB(3,250),NLNKS,MINTAN(2,40),
     1    MAXTAN(2,40),NKEY,NXYZ,ICOLOR(4),FLESH,FACTR,SCLE
      INTEGER HIER(20),FLESH
C
C   PLOT MAN-MODEL AND CREW STATION
C
C   CALCULATE PLOTTING FACTOR
      SCALE=FACTR/SCLE
      IF(FACTR.EQ.99.) SCALE=1.
      CALL FACTOR(SCALE)
C
C   PLOT THE LINK SYSTEM
C
      J=IABS(KEYTAB(2,1))
      HIER(J)=1
      CALL PLOT(X(1),Y(1),3)
      DO 50 I=2,NLNKS
C
C   SPECIFY COLOR FOR LINK SYSTEM
      CALL NEWPEN(ICOLOR(2))
C
       J=IABS(KEYTAB(2,I))
       K=KEYTAB(1,I)
       HIER(J)=I
C   LOCATE COORDINATE OF PREVIOUS POINT IN THE CHAIN
      L=HIER(J-1)
       CALL PLOT(X(L),Y(L),3 )
   10  M=2
```

```
C    CHECK IF OMIT OR INCLUDE STATUS                                    J0028600
        IF (KEYTAB(2,I).LT.0.AND.KEYTAB(3,I).LT.0) M=3                  J0028700
        CALL PLOT(X(I),Y(I),M)                                          00028800
        J=IABS(KEYTAB(3,I))                                             00028900
        IF (J.EQ.1) GO TO 50                                            00029000
C                                                                       00029100
C    PLOT ENFLESHED MAN-MODEL                                           00029200
       IF(FLESH.EQ.1)  GO TO 50                                         00029300
    30 KP=KEYTAB(1,I)+NLNKS-1                                           00029400
C                                                                       00029500
C    SPECIFY COLOR FOR ENFLESHMANT                                      00029600
C                                                                       00029700
        CALL NEWPEN(ICOLOR(3))                                          00029800
        L1=KP+KEYTAB(3,2)-2                                             00029900
    35  DO 45 L2=KP,L1                                                  00030000
         CALL SYMBOL(X(L2)-.04,Y(L2),.175,1H.,0.0,1,.175,0)             00030100
    45  CONTINUE                                                        00030200
        IF (MINTAN(1,I).EQ.0) GO TO 50                                  00030300
        L1=MINTAN(1,I)+NLNKS                                            00030400
        L2=MINTAN(2,I)+NLNKS                                            00030500
        CALL PLOT(X(L1),Y(L1),3)                                        00030600
        CALL PLOT(X(L2),Y(L2),2)                                        00030700
        L1=MAXTAN(1,I)+NLNKS                                            00030800
        L2=MAXTAN(2,I)+NLNKS                                            00030900
        CALL PLOT(X(L1),Y(L1),3)                                        00031000
        CALL PLOT(X(L2),Y(L2),2)                                        00031100
    50 CONTINUE                                                         00031200
C                                                                       00031300
C    PLOT CREW STATION PANELS                                           00031400
C                                                                       00031500
        IF (NLNKS.EQ.NKEY) RETURN                                       00031600
        II=NLNKS+1                                                      00031700
C                                                                       00031800
C    SPECIFY COLOR FOR CREW STATION                                     00031900
C                                                                       00032000
        CALL NEWPEN(ICOLOR(4))                                          00032100
        DO 80 I=II,NKEY                                                 00032200
         K=KEYTAB(1,I)+NXYZ+NLNKS                                       00032300
         CALL PLOT(X(K),Y(K),3)                                         00032400
         M=2                                                            00032500
         IF (KEYTAB(2,I).LT.0.AND.KEYTAB(3,I).LT.0) M=3                 00032600
         J=IABS(KEYTAB(3,I))                                            00032700
         L=K+1                                                          00032800
         K=K+J-1                                                        00032900
         DO 60 J=L,K                                                    00033000
    60   CALL PLOT(X(J),Y(J),M)                                         00033100
    80 CONTINUE                                                         00033200
       RETURN                                                           00033300
       END                                                              00033400
```

APPENDIX D

JCL AND DATA REQUIRED TO CREATE 67 USAF AND 70 ARMY SURVEY MEMBERS AND R67 USAF AND R70 ARMY REGRESSION MEMBERS OF THE COMBIMAN ANTHROPOMETRIC DATA BASE

```
//CBMAM     JOB HESS                                                            00001000
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR                                    00001100
//CBMAM     EXEC PGM=CBMAM                                                      00001200
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,DISP=SHR                                    00001300
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,UNIT=DISK,DISP=(NEW,CATLG),                 00001300
//             VOL=SER=DISK01,SPACE=(248,2000),                                 00001310
//             DCB=(BLKSIZE=248,LRECL=248,RECFM=FB)                             00001320
//FT05F001 DD DDNAME=SYSIN                                                      00001400
//FT06F001 DD SYSOUT=A                                                          00001500
//FT07F001 DD SYSOUT=B                                                          00001600
//SYSUDUMP DD SYSOUT=A                                                          00001700
//SYSIN     DD *                                                                00001800
*INT
*ACD R67 USAF    C  17  24  12
 1 WEIGHT             LB    1         1
 2 SITTING HEIGHT     IN          1   1
 3 EYE HGT/SITTING    IN          1
 4 ACROMION HGT/SIT   IN              1
 5 KNEE HGT/SITTING   IN          1   1
 6 BUTTOCK-KNE LGTH   IN          1   1
 7 SHOULDR-ELB LGTH   IN              1
 8 ELBOW-GRIP LGTH    IN          1
 9 THUMB-TIP REACH    IN          1
10 BIACROMIAL BRDTH   IN              1
11 BIDELTIOD BRDTH    IN    1
12 HIP BREADTH        IN              1
13 HIP BREADTH/SITT   IN    1
14 CHEST DEPTH        IN    1         1
15 FOOT LENGTH        IN              1
16 HAND LENGTH        IN              1
17 ELBOW-WRIST LGTH   IN              1
  1  2         0.02669  32.05275   1.11161   7.84530-114.20851  19.00910
  1  2  1  1.0        0.0         0.0
  1  2  2  0.0        1.0000000   0.0
  1  2  4  0.0076260 0.6716000  -1.02367
  1  2  5  0.0175512 0.2668000   9.12241
  1  2  6  0.0286654 0.1086000  14.62455
  1  2  7  0.0075787 0.1875000   5.45586
  1  2 10  0.0131732 0.1105000   9.05417
  1  2 12  0.0279173 0.0043000   8.37957
  1  2 14  0.0313031-0.1665000  10.32953
  1  2 15  0.0069724 0.1248000   4.85468
  1  2 16  0.0034882 0.0892000   3.04523
  1  2 17  0.0070    0.14032     5.43352
  1  3         0.02287  27.89853   1.08110   7.45057 -64.02751  [illegible]
  1  3  1  1.0        0.0         0.0
  1  3  2             0.979       5.4[illegible]241
  1  3  4             0.737       0.55115
  1  3  5  0.0180181 0.2646000  10.25247
  1  3  6             0.349      12.[illegible]
  1  3  7  0.0074843 0.2011000   [illegible]
  1  3 10  0.0141014 0.0857000  10.[illegible]
  1  3 12  0.0278189 0.0093000   [illegible]
  1  3 14  0.0304921-0.1587000   9.[illegible]
  1  3 15  0.0079236 0.1215000   5.[illegible]
  1  3 16  0.0039528 0.0837000   4.[illegible]
  1  3 17  0.00815   0.11474     [illegible]
  1  5         0.02470  17.00583   [illegible]  11.76174 -34.[illegible]  [illegible]
  1  5  1  1.0        0.0         0.0
```

```
 1  5  2  0.0147402 0.4820000  23.54443
 1  5  4  0.0182126 0.2959000  14.37994
 1  5  5  0.0       1.0000000   0.0
 1  5  6  0.0149094 0.6751000   6.37241
 1  5  7 -0.0001969 0.5180000   2.81440
 1  5 10  0.0125630 0.1442000  10.66774
 1  5 12  0.0282283-0.0081000   9.16118
 1  5 14  0.0301890-0.1347000   7.37250
 1  5 15  0.0030315 0.2947000   3.64651
 1  5 16  0.0007795 0.2061000   2.66251
 1  5 17 -.00029    0.45137     1.75212
 1  6       0.03158  18.29894   0.62139  12.61257-131.00403  10.53998
 1  6  1  1.0       0.0         0.0
 1  6  2  0.0203268 0.1995000  28.41290
 1  6  4  0.0238937 0.0511000  18.67546
 1  6  5  0.0029961 0.6863000   5.11351
 1  6  6  0.0       1.0000000   0.0
 1  6  7 -0.0023189 0.4719000   3.35250
 1  6 10  0.0158071 0.0097000  13.06010
 1  6 12  0.0267283 0.0412000   8.26375
 1  6 14  0.0293819-0.0795000   6.44503
 1  6 15  0.0033780 0.2192000   4.04350
 1  6 16  0.0010945 0.1510000   3.74106
 1  6 17  0.00064   0.32354     4.00511
 1  8       0.01212  11.75517   0.58143  13.73200 -16.71603  19.56716
 1  8  1  1.0       0.0         0.0
 1  8  2  0.0187717 0.6476000  24.45120
 1  8  4  0.0207835 0.3897000  15.02894
 1  8  5  0.0120472 1.0400000   5.44953
 1  8  6  0.0227087 0.7297000   9.72802
 1  8  7  0.0046850 0.6506000   4.32242
 1  8 10  0.0132520 0.2362000  10.46027
 1  8 12  0.0278150 0.0176000   8.41113
 1  8 14  0.0287244-0.1523000   6.78696
 1  8 15  0.0053740 0.4061000   4.00147
 1  8 16  0.0018110 0.3342000   2.87625
 1  8 17  0.00147   0.76746     0.91849
 1  9       0.03029  26.35823   1.42612   5.66767  -5.56512  19.55335
 1  9  1  1.0       0.0         0.0
 1  9  2  0.0200827 0.2163000  26.36073
 1  9  4  0.0216575 0.1273000  16.25370
 1  9  5  0.0137441 0.3609000   8.15526
 1  9  6  0.0231181 0.2790000  10.94946
 1  9  7  0.0045591 0.2650000   4.98305
 1  9 10  0.0136811 0.0805000  11.11436
 1  9 12  0.0281693-0.0046000   9.13904
 1  9 14  0.0279646-0.0362000   8.64550
 1  9 15  0.0063701 0.1298000   5.49332
 1  9 16  0.0027402 0.1032000   3.78424
 1  9 17  0.00407   0.22238     4.07115
11  2       0.34567  30.12037   1.20048   0.22338  10.72927   0.40734
11  2  1 10.9508     0.0       -148.383
11  2  2  0.0       1.0000000   0.0
11  2  4  0.0561000 0.7201000  -3.33152
11  2  5  0.2071000 0.3578000   4.89793
11  2  6  0.3755000 0.2486000   7.52844
11  2  7  0.0960000 0.2267000   4.14799
11  2 10  0.4660000 0.1104000   9.24905
11  2 12  0.4129000 0.1303000   1.00101
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11	2	14	0.4789000	-0.0286000	1.81592			
11	2	15	0.0673000	0.1599000	3.12040			
11	2	16	0.0451000	0.1064000	2.76362			
11	2	17	0.06443	0.17618	3.71343			
11	3		0.30610	26.05530	1.14819	0.22134	11.93965	[illegible]
11	3	1	16.9568	0.0	-148.083			
11	3	2	0.0485000	0.9683000	4.50794			
11	3	4	0.0762000	0.7196000	-0.37902			
11	3	5	0.2222000	0.3540000	6.45692			
11	3	6	0.3302000	0.2650000	8.11942			
11	3	7	0.0949000	0.2395000	4.71523			
11	3	10	0.4715000	0.0869000	4.31225			
11	3	12	0.4201000	0.1234000	1.97291			
11	3	14	0.4806000	-0.0381000	1.74185			
11	3	15	0.0945000	0.1566000	3.85737			
11	3	16	0.0506000	0.1019000	3.31475			
11	3	17	0.0983	0.15392	5.03787			
11	5		0.33166	15.65472	0.92347	0.35026	11.30531	[illegible]
11	5	1	16.9568	0.0	-148.083			
11	5	2	0.1445000	0.6049000	20.65974			
11	5	4	0.1465000	0.4585000	11.17997			
11	5	5	0.0	1.0000000	0.0			
11	5	6	0.2038000	0.7793000	2.80354			
11	5	7	-0.0025000	0.5165000	2.86006			
11	5	10	0.4540000	0.1333000	4.48022			
11	5	12	0.3965000	0.1854000	2.28117			
11	5	14	0.4478000	0.0640000	-0.25567			
11	5	15	0.0376000	0.3172000	2.96457			
11	5	16	0.0120000	0.2111000	2.85990			
11	5	17	-.00286	0.449	2.0387			
11	6		0.46362	14.97491	0.95564	0.41724	9.07114	[illegible]
11	6	1	16.9568	0.0	-148.083			
11	6	2	0.1633000	0.3924000	24.25101			
11	6	4	0.1647000	0.2892000	14.03161			
11	6	5	-0.0049000	0.7268000	4.76283			
11	6	6	0.0	1.0000000	0.0			
11	6	7	-0.0443000	0.4000000	4.04089			
11	6	10	0.4949000	0.0068000	6.47457			
11	6	12	0.3472000	0.2399000	1.58527			
11	6	14	0.4105000	0.1268000	-1.1[illegible]			
11	6	15	0.0263000	0.2516000	4.15808			
11	6	16	0.0069000	0.1622000	3.53315			
11	6	17	-.00985	0.3359	4.00924			
11	8		0.15360	10.84653	0.61644	[illegible]	13.[illegible]	[illegible]
11	8	1	16.9568	0.0	-148.083			
11	8	2	0.2143000	0.8205000	21.24226			
11	8	4	0.2039000	0.5945000	11.52815			
11	8	5	0.1487000	1.1465000	3.24095			
11	8	6	0.3160000	0.9163000	5.08151			
11	8	7	0.0585000	0.6918000	3.45366			
11	8	10	0.4608000	0.2348000	4.02053			
11	8	12	0.4209000	0.2326000	2.80405			
11	8	14	0.4596000	0.0593000	0.10500			
11	8	15	0.0738000	0.4518000	3.03817			
11	8	16	0.0265000	0.3485000	2.14825			
11	8	17	0.02136	0.77904	0.60007			
11	9		0.43448	23.36423	1.50431	0.16032	13.[illegible]	[illegible]
11	9	1	16.9568	0.0	-148.083			
11	9	2	0.2187000	0.2308000	23.32741			

11	9	4	0.2061000	0.2130000	13.39023			
11	9	5	0.1526000	0.4113000	5.05256			
11	9	6	0.3080000	0.3547000	6.72016			
11	9	7	0.0460000	0.2825000	4.54560			
11	9	10	0.4659000	0.0744000	4.83470			
11	9	12	0.4237000	0.0790000	3.34054			
11	9	14	0.4512000	0.0413000	-0.21794			
11	9	15	0.0767000	0.1521000	4.37728			
11	9	16	0.0330000	0.1128000	3.32874			
11	9	17	0.04217	0.23784	3.46964			
13	2		0.46318	29.79372	1.17767	0.24312	5.[illegible]	0.[illegible]
13	2	1	20.2776	0.0	-127.757			
13	2	2	0.0	1.0000000	0.0			
13	2	4	0.1080000	0.6906000	-3.80543			
13	2	5	0.2883000	0.3346000	5.39215			
13	2	6	0.5505000	0.2001000	8.25307			
13	2	7	0.1233000	0.2171000	4.35481			
13	2	10	0.1935000	0.1669000	7.03065			
13	2	12	0.7167000	0.0498000	1.39459			
13	2	14	0.5539000	-0.0551000	3.43517			
13	2	15	0.1106000	0.1527000	3.39454			
13	2	16	0.0432000	0.1061000	2.96915			
13	2	17	0.10648	0.16981	3.5954			
13	3		0.40811	25.79650	1.12810	0.23757	7.30867	0.[illegible]
13	3	1	20.2776	0.0	-127.757			
13	3	2	0.0714000	0.9622000	4.55987			
13	3	4	0.2084000	0.6878000	-0.96413			
13	3	5	0.3088000	0.3305000	6.83155			
13	3	6	0.5543000	0.2186000	8.57025			
13	3	7	0.1303000	0.2296000	4.88594			
13	3	10	0.2134000	0.1408000	8.37005			
13	3	12	0.7207000	0.0468000	1.67072			
13	3	14	0.5537000	-0.0621000	3.39651			
13	3	15	0.1206000	0.1491000	4.09600			
13	3	16	0.0511000	0.1010000	3.54131			
13	3	17	0.12552	0.14577	5.29044			
13	5		0.44387	15.34930	0.89625	0.37738	0.59500	[illegible]
13	5	1	20.2776	0.0	-127.757			
13	5	2	0.2035000	0.5786000	20.95363			
13	5	4	0.3123000	0.3923000	10.77303			
13	5	5	0.0	1.0000000	0.			
13	5	6	0.3193000	0.7298000	3.00100			
13	5	7	-0.0059000	0.5179000	2.07129			
13	5	10	0.1694000	0.2281000	8.50694			
13	5	12	0.7157000	0.0540000	2.04980			
13	5	14	0.5175000	0.0253000	1.40055			
13	5	15	0.0417000	0.3148000	3.11505			
13	5	16	-0.0039000	0.2168000	2.52175			
13	5	17	-.01526	0.4533	2.37525			
13	6		0.64324	14.20519	0.39041	0.46605	5.79715	[illegible]
13	6	1	20.2776	0.0	-127.757			
13	6	2	0.2337000	0.3511000	24.85823			
13	6	4	0.3057000	0.1868000	14.19367			
13	6	5	-0.0338000	0.7460000	4.94516			
13	6	6	0.0	1.0000000	0.0			
13	6	7	-0.0873000	0.4829000	3.36577			
13	6	10	0.1909000	0.1234000	10.25960			
13	6	12	0.7041000	0.0552000	2.09503			
13	6	14	0.4824000	0.0720000	0.75467			

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13  6 15  0.0173000 0.2545000   4.33329
13  6 16 -0.0203000 0.1746000   3.07240
13  6 17  -.03821   0.34572     4.06231
13  8       0.20220  10.85128   0.61001   0.40851   9.21250   0.66749
13  8  1 20.2776    0.0       -127.757
13  8  2  0.3010000 0.7823000  21.36335
13  8  4  0.3607000 0.5194000  11.17498
13  8  5  0.2161000 1.1170000   3.25641
13  8  6  0.4707000 0.8490000   5.01346
13  8  7  0.0855000 0.6800000   3.45666
13  8 10  0.2023000 0.3355000   8.37303
13  8 12  0.7182000 0.1055000   1.73571
13  8 14  0.5230000 0.0277000   1.40880
13  8 15  0.0913000 0.4426000   3.15125
13  8 16  0.0210000 0.3505000   2.35251
13  8 17  0.02796   0.77609     0.6373
13  9       0.51279  23.98611   1.49653   0.17133   9.46316   0.66564
13  9  1 20.2776    0.0       -127.757
13  9  2  0.3181000 0.2754000  23.24312
13  9  4  0.3922000 0.1827000  12.42797
13  9  5  0.2382000 0.3978000   5.83377
13  9  6  0.4741000 0.3286000   6.34104
13  9  7  0.0812000 0.2769000   4.19169
13  9 10  0.2075000 0.1224000   9.07808
13  9 12  0.7238000 0.0308000   2.14232
13  9 14  0.5110000 0.0345000   0.96138
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13  9 16  0.0340000 0.1129000   3.44645
13  9 17  0.06499   0.23425     3.43595
14  2       0.21453  34.61474   1.23950   0.07920   0.74895   0.75510
14  2  1 21.4816    0.0       -33.422
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14  2  4  0.1437000 0.7200000  -3.76470
14  2  5  0.2874000 0.3817000   5.18029
14  2  6  0.5216000 0.2921000   8.33195
14  2  7  0.1355000 0.2362000   4.17877
14  2 10  0.2285000 0.1957000   8.04778
14  2 12  0.5291000 0.1814000   2.12145
14  2 14  1.0000000 0.0         0.0
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14  2 16  0.0615000 0.1117000   2.83253
14  2 17  0.11557   0.18664     3.84e9
14  3       0.16752  30.25192   1.18627   0.06858   7.46870   0.75520
14  3  1 21.4816    0.0       -33.422
14  3  2  0.0513000 0.9755000   5.10303
14  3  4  0.1769000 0.7248000  -0.76884
14  3  5  0.3053000 0.3823000   6.82635
14  3  6  0.5320000 0.3217000   8.66135
14  3  7  0.1443000 0.2507000   4.77250
14  3 10  0.2413000 0.1746000   8.14078
14  3 12  0.5379000 0.1796000   2.96665
14  3 14  1.0000000 0.0         0.0
14  3 15  0.1229000 0.1691000   4.06737
14  3 16  0.0673000 0.1085000   3.41576
14  3 17  0.12753   0.16681     5.263
14  5       0.36704  18.41054   0.94169   0.21947   4.83601   0.72034
14  5  1 21.4816    0.0       -33.422
14  5  2 -0.0305000 0.6621000  22.44211
14  5  4  0.1191000 0.4838000  12.26425
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14  5  5  0.0        1.0000000   0.0
14  5  6  0.2942000 0.7856000   3.69406
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14  5 12  0.4880000 0.2164000   4.42040
14  5 14  1.0000000 0.0         0.0
14  5 15  0.0317000 0.3234000   3.23744
14  5 16  0.0064000 0.2139000   2.76474
14  5 17  -.00934   0.45006     2.02139
14  6        0.58391  18.14341   0.96724   0.29754   2.57875   0.59045
14  6  1 21.4816    0.0        -33.422
14  6  2 -0.0666000 0.4801000  25.50939
14  6  4  0.1074000 0.3258000  15.29306
14  6  5 -0.0657000 0.7443000   4.86775
14  6  6  0.0        1.0000000   0.0
14  6  7 -0.0874000 0.4632000   3.86291
14  6 10  0.1769000 0.1600000  10.52173
14  6 12  0.4156000 0.2606000   3.67241
14  6 14  1.0000000 0.0         0.0
14  6 15 -0.0028000 0.2634000   4.40554
14  6 16 -0.0134000 0.1691000   3.63065
14  6 17  -.04538   0.34534     4.0357
14  8        0.16829  12.23530   0.62395   0.23936   6.33689   0.74412
14  8  1 21.4316    0.0        -33.422
14  8  2  0.0619000 0.8910000  23.73835
14  8  4  0.1903000 0.6296000  13.47361
14  8  5  0.1704000 1.1645000   4.17059
14  8  6  0.4238000 0.9395000   6.66929
14  8  7  0.0668000 0.6989000   3.62100
14  8 10  0.2075000 0.3683000   8.92597
14  8 12  0.5211000 0.2741000   5.05256
14  8 14  1.0000000 0.0         0.0
14  8 15  0.0721000 0.4625000   3.53542
14  8 16  0.0252000 0.3530000   2.36703
14  8 17  0.02311   0.78198     0.74667
14  9        0.51986  26.59757   1.61637   0.12216   5.79212   0.75507
14  9  1 21.4816    0.0        -33.422
14  9  2  0.0448000 0.3246000  25.99103
14  9  4  0.1789000 0.2281000  15.09896
14  9  5  0.1500000 0.4203000   7.21663
14  9  6  0.3957000 0.3616000   8.53055
14  9  7  0.0369000 0.2863000   4.74527
14  9 10  0.2008000 0.1334000   9.87646
14  9 12  0.5202000 0.0914000   5.97064
14  9 14  1.0000000 0.0         0.0
14  9 15  0.0690000 0.1574000   4.99869
14  9 16  0.0251000 0.1157000   3.62236
14  9 17  0.0296    0.24179     3.37893
+ACD 67 USAF     1  17   24   12   25   RC7 USAF
 1 2 3 510152025303540455055606570756085095579899
 1 WEIGHT            LB 173.60686 21.43470412750132031356214015140691015
155271585016156164371670810974172421751217752106841039710741191321454
20133210762160222094227773
 2 SITTING HEIGHT    IN 36.665932 1.2501624 3394 3424 3444 3470 3511 3533
 3562 3562 3600 3617 3633 3649 3665 3681 3698 3715 3733 3755 3775 38.1
 3833 3880 3910 3931 3962
 3 EYE HGT/SITTING  IN 31.269176 1.1671142 2917 2950 2971 2995 3030 3005
 3037 3105 3123 3138 3153 3168 3133 3198 3213 3229 3240 3255 3280 3311
 3343 3390 3421 3443 3478
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 4 ACROMION HGT/SIT IN 24.03621  1.123410  2142 2177 2197 2224 2263 2289
 2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522
 2551 2594 2620 2639 2666
 5 KNEE HGT/SITTING IN 21.95673   .586041   1973 1998 2015 2037 2071 2095
 2113 2129 2143 2157 2169 2182 2194 2206 2219 2231 2245 2260 2277 2296
 2322 2360 2386 2405 2436
 6 BUTTOCK-KNE LGTH IN 23.78431  1.062304   2138 2165 2183 2207 2244 2269
 2289 2306 2322 2336 2350 2363 2376 2389 2402 2416 2431 2447 2465 2486
 2514 2557 2587 2610 2648
 7 SHOULDR-ELB LGTH IN 14.15382   .674011   1265 1281 1291 1300 1329 1349
 1357 1366 1379 1388 1397 1406 1414 1423 1432 1441 1451 1461 1473 1486
 1503 1528 1544 1555 1573
 8 ELBOW-GRIP LGTH  IN 13.86133   .633554    1247 1261 1270 1283 1304 1319
 1331 1342 1351 1360 1369 1377 1385 1393 1401 1410 1419 1429 1440 1452
 1469 1493 1509 1521 1540
 9 THUMB-TIP REACH  IN 31.62047  1.564982   2804 2846 2872 2908 2964 3001
 3030 3056 3079 3100 3120 3139 3156 3176 3198 3218 3240 3264 3291 3322
 3364 3427 3469 3502 3555
10 BIACROMIAL BRDTH IN 16.03454   .764311   1416 1441 1456 1475 1505 1525
 1541 1554 1566 1576 1586 1596 1605 1614 1624 1633 1643 1654 1666 1680
 1698 1726 1744 1758 1782
11 BIDELTOID BRDTH  IN 18.99046  1.000841   1667 1696 1714 1737 1772 1795
 1814 1830 1844 1858 1871 1884 1896 1909 1922 1936 1951 1967 1985 2005
 2032 2071 2097 2115 2142
12 HIP BREADTH      IN 13.88310  .741637    1221 1241 1254 1271 1297 1314
 1328 1339 1350 1359 1368 1377 1386 1395 1404 1413 1423 1434 1447 1462
 1482 1515 1537 1555 1584
13 HIP BREADTH/SITT IN 14.87821   .790583    1256 1310 1325 1345 1375 1396
 1412 1426 1439 1451 1462 1473 1484 1495 1508 1518 1531 1545 1561 1580
 1605 1644 1670 1690 1723
14 CHEST DEPTH      IN  9.65481   .75788     798  814  825  841  867  885
  900  913  925  936  946  956  965  975  985  994 1005 1016 1029 1043
 1062 1090 1110 1124 1149
15 FOOT LENGTH      IN 10.64335   .468125    957  970  979  989 1006 1017
 1025 1033 1039 1046 1052 1057 1063 1069 1075 1081 1088 1095 1103 1113
 1125 1144 1156 1165 1180
16 HAND LENGTH      IN  7.52310   .322307    679  698  693  706  711  719
  725  730  735  739  743  747  751  755  760  764  769  774  779  786
  794  807  815  821  830
17 ELBOW-WRIST LGTH IN 11.81      .50        1052 1068 1077 1090 1110 1124
 1134 1145 1151 1159 1166 1173 1180 1187 1194 1201 1209 1218 1227 1238
 1253 1274 1288 1299 1316
*ACD R70 ARMY   0  17  24  12
 1 WEIGHT           LB   1        1
 2 SITTING HEIGHT   IN        1   1
 3 EYE HGT/SITTING  IN        1
 4 ACROMION HGT/SIT IN            1
 5 KNEE HGT/SITTING IN        1   1
 6 BUTTOCK-KNE LGTH IN        1   1
 7 SHOULDR-ELB LGTH IN            1
 8 ELBOW-GRIP LGTH  IN        1
 9 THUMB-TIP REACH  IN        1
10 BIACROMIAL BRDTH IN            1
11 BIDELTOID BRDTH  IN    1
12 HIP BREADTH      IN            1
13 HIP BREADTH/SITT IN    1
14 CHEST DEPTH      IN    1       1
15 FOOT LENGTH      IN            1
16 HAND LENGTH      IN            1
```

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17 ELBOW-ARIST LGTH IN                                  1
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  1  2  1     1.00000    0.0        0.0
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 3743 3791 3823 3847 3884
 3 EYE HGT/SITTING   IN       3102       1.25 2905 2943 2967 2998 2945 2976
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 3260 3309 3341 3366 3407
 4 ACROMION HGT/SIT IN       2340       1.16 2063 2100 2122 2150 2192 2220
 2242 2261 2278 2294 2309 2324 2338 2353 2369 2385 2401 2420 2440 2464
 2493 2533 2557 2573 2595
 5 KNEE HGT/SITTING IN       2087       1.01 1859 1886 1903 1926 1961 1984
 2003 2019 2033 2047 2059 2072 2084 2096 2109 2122 2136 2151 2169 2190
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 6 BUTTOCK-KNE LGTH IN       2370       1.04 2138 2162 2179 2201 2237 2262
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 2503 2542 2569 2588 2620
 7 SHOULDR-ELB LGTH IN       1445        .70 1287 1304 1315 1331 1356 1375
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 8 ELBOW-GRIP LGTH  IN       1322        .60 1185 1199 1209 1223 1244 1259
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 1397 1421 1437 1450 1473
 9 THUMB-TIP REACH  IN       3124       1.62 2796 2824 2846 2877 2924 2956
 2985 3009 3031 3052 3072 3092 3112 3132 3154 3176 3200 3227 3257 3293
 3341 3413 3461 3498 3555
10 BIACROMIAL BRDTH IN       1601        .77 1411 1435 1450 1470 1501 1521
 1537 1550 1562 1573 1584 1593 1603 1613 1622 1632 1643 1654 1666 1683
 1698 1724 1741 1753 1772
11 BIDELTOID BRDTH  IN       1666       1.01 1646 1666 1680 1701 1735 1756
 1779 1796 1812 1826 1839 1853 1866 1878 1891 1905 1919 1934 1951 1976
 1995 2032 2056 2075 2105
12 HIP BREADTH      IN       1383        .39 1196 1217 1231 1249 1277 1296
 1311 1325 1337 1348 1359 1369 1380 1390 1401 1413 1425 1439 1455 1476
 1493 1526 1546 1564 1588
13 HIP BREADTH/SITT IN       1486       1.07 1262 1283 1298 1315 1342 1375
 1396 1413 1428 1443 1457 1471 1484 1498 1512 1527 1542 1559 1578 1606
 1629 1672 1700 1722 1757
```

```
14 CHEST DEPTH        IN        947        .89  761  77c  787  5c3  83z  853
  870  885  898  911  923  934  946  957  969  981  993 1007 1022 1039
 1062 1096 1118 1136 1164
15 FOOT LENGTH        IN       1043        .50  927  941  950  962  98c  99z
 1001 1009 1017 1023 1030 1036 1043 1049 1055 1062 1069 1077 1085 1095
 1108 1126 1138 1146 1158
16 HAND LENGTH        IN        756        .34  67c  68c  691  699  71z  72c
  727  733  738  743  747  751  755  76C  764  7cc  773  77c  784  791
  800  814  824  832  845
17 ELBOW-WRIST LGTH IN         1139        .57 1010 1023 1033 1046 1066 1081
 1092 1102 1110 1118 1126 1133 114C 1147 1154 1161 1168 117c 118c 119c
 1210 1233 1248 1261 1282
*END
/*
//
```

APPENDIX E

JCL AND DATA REQUIRED TO CREATE THE COMBIMAN CREW STATION DATA BASE MEMBER A7E-01

```
//CBMCM     JOB HESS                                                        00001000
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR                                00001100
//CBMCM     EXEC PGM=CBMCM                                                  00001200
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,UNIT=DISK,DISP=(NEW,CATLG),             00001300
//            VOL=SER=DISK01,SPACE=(368,2000),                              00001310
//            DCB=(BLKSIZE=368,LRECL=368,RECFM=FB)                          00001320
//FT05F001 DD DDNAME=SYSIN                                                  00001400
//FT06F001 DD SYSOUT=A                                                      00001500
//FT07F001 DD SYSOUT=B                                                      00001600
//SYSUDUMP DD SYSOUT=A                                                      00001700
//SYSIN     DD *                                                            00001800
$INT
$ACC A7E-01     46  46   0.0   0.0   0.0 F L U
  1LMIPAN         16  2975   000   594  2975  1475   594  3134  1475  1359
  3259   957  1930  3320   450  2214  3320   000  2300
  2RMIPAN         16  2975   000   594  2975 -1475   594  3134 -1475  1359
  3259  -957  1930  3320  -450  2214  3320   000  2300
  3FWDLHCON       15  2623   925   289  2623  1875   289  2631  [illegible]  [illegible]
  2979  1718   593  2979   928   593
  4LHCCN          14  2609   925   276  -840   925   276  -840  2301  276
  2609  2000   275
  5AFTLHCON       14  -335   850   276  -853   850   276  -853  [illegible]  276
  -340  2300   275
  6FWDRHCON       15  2623  -925   289  2623 -1875   289  2631  [illegible]  [illegible]
  2979 -1718   593  2979  -928   593
  7RHCCN          14  2609  -925   276  -840  -925   276  -840 -2300   276
  2609 -2000   275
  8CNSWLFSD       14  2610   925   276  -336   925   276  -336   [illegible]  -932
  2610   925  -932
  9CNSWLSRH       14  2610  -925   276  -336  -925   276  -336  [illegible]  -932
  2610  -925  -932
 10UWPRLPAN       14  2974  -478   593  2947  -308   463  2947  [illegible]  463
  2979   478   593
 11LWPFLPAN       14  2947  -308   463  2964  -245   264  2964   245   264
  2949   308   463
 12THRTLLSD       16  1996  1393   790  1931  1393   755  1882  [illegible]  [illegible]
  1969  1388   513  2089  1388   693  2089  1388   763
 13THRTLFWD       14  2092  1393   694  1975  1393   518  1975  [illegible]  518
  2089  1138   693
 14THRTLRSD       16  1996  1141   790  1931  1141   755  1882  1141   [illegible]
  1969  1138   513  2089  1138   693  2089  1138   763
 15THRTLAFT       14  1931  1141   765  1852  1141   559  1882  [illegible]  [illegible]
  1929  1388   763
 16THRTPAFT       14  1996  1141   790  1931  1141   765  [illegible]  [illegible]  [illegible]
  1999  1388   793
 17THRTLTPC       14  2066  1141   760  1990  1141   [illegible]  1990  [illegible]  [illegible]
  2069  1388   763
 18THRTPFWD       14  2092  1141   694  2066  1141   [illegible]  [illegible]  [illegible]  [illegible]
  2089  1388   693
 19THRLGAFT       14  1905  1216   545  1783  1216   276  1783  [illegible]  [illegible]
  1909  1313   543
 20THRLGFWD       14  1950  1216   527  [illegible]  1216   [illegible]  [illegible]  [illegible]  [illegible]
  1949  1318   525
 21GLSHIP         14  2090    00  2602  [illegible]  [illegible]  1776  [illegible]  [illegible]  1776
  2090    00  2604
 22FJDSCRN        14  2209   374  3228  [illegible]  -374  3228  [illegible]  -374  2447
  2991   374  2447
 23CWFLLL         16  1730  1400  1494  1994  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
  2230  1136  2995  1994  1390  2462  1730  1401  1444
```

```
24CwFMLL        16   2208   1135   2995   2261   1000   3128   2365    500   3389
  2365    501  3389   2261   1001   3125   2208   1136   2995
25CwFCL         16   2365    500   3389   2334    000   3433   2365   -500   3389
  2365   -500  3390   2384     00   3434   2365    500   3390
26CwFMRL        16   2365   -500   3389   2261  -1000   3128   2208  -1135   2995
  2208  -1136  2995   2261  -1001   3128   2365   -501   3389
27CwFLRL        16   2208  -1135   2995   1994  -1365   2466   1730  -1401   1494
  1730  -1401  1494   1994  -1390   2466   2208  -1136   2995
28CwRLLL        16  -1158   1782   1494  -1649   1500   2893  -1830   1201   3409
 -1830   1201  3409  -1649   1501   2893  -1158   1783   1494
29CwRMLL        16  -1830   1200   3409  -1942    900   3730  -2014    600   3934
 -2014    601  3934  -1942    901   3730  -1830   1201   3409
30CwRCLL        16  -2014    600   3934  -2054    300   4046  -2067    000   4085
 -2067    000  4086  -2054    301   4048  -2014    601   3934
31CwRURL        16  -2067    000   4085  -2054   -300   4048  -2014   -600   3934
 -2014   -601  3934  -2054   -301   4048  -2067    000   4086
32CwRMRL        16  -2014   -600   3934  -1942   -900   3730  -1830  -1200   3409
 -1830  -1201  3409  -1942   -901   3730  -2014   -601   3934
33CwRLRL        16  -1830  -1200   3409  -1650  -1500   2893  -1158  -1782   1494
 -1158  -1783  1494  -1649  -1501   2893  -1830  -1201   3409
34CwLBL         14   1730   1400   1494   1730   1405   1494  -1156   1787   1494
 -1156   1782  1494
35CwRBL         14   1730  -1400   1494   1730  -1405   1494  -1158  -1787   1494
 -1158  -1782  1494
36CFTRLL        14  -2067    001   4085    550    001   4072    550   -001   4072
 -2067   -001  4085
37CFTMCL        14    550    001   4072   1553    001   3884   1553   -001   3884
   550   -001  4072
38CFTFCL        14   1553    001   3884   2665    001   3347   2665   -001   3347
  1553   -001  3884
39WWOSCRN       14   2665    001   3347   5718    001   1778   5715   -001   1778
  2665   -001  3347
40LRDRPDL       14   3748   1007     85   3748    463     85   3477    463   -653
  3477   1007   -653
41RRDRPDL       14   3748  -1007     85   3748   -463     85   3477   -463   -653
  3477  -1007   -653
42FLRLINE       14    391    925   -945   2131    925   -945   2131   -925   -945
   391   -925   -945
43LMLRSTLN      13   2131    925   -945   4206    925  -1161   4226    925   -945

44RMLRSTLN      13   2131   -925   -945   4206   -925  -1161   4226   -925   -945

45CMLRSTLN      14   4226    925   -945   4206    925  -1161   4203   -925  -1161
  4226   -925   -945
46MUDFACE       14   2090     00   2602   2355     00   2139   3221      0   1778
  3320     00   2300
AFTPTLI         0   00  -1108   2600   3125
AFTPTREA        0   00  -2958      0   2275
AFTPTRT         0   00  -1108  -2000  -9913
EMERPUMP        0   00   2589   1675    654
FCCATG          0   00   2059   1250    800
FCFRDOWN        0   00   2379  -1602    564
FCFRUP          0   00   2649  -1602    793
FCLDSURG        0   00   2609   1043    600
FCRUDPDA        0   00   2784      0    114
FCSTRMPA        0   00   1647     34   1126
FCSTRMPM        0   00   2027     34   1151
FCTPADS         0   00   1509    975     35
FCTRKTLA        0   00   1116   1260    720
```

AD-A097 705 DAYTON UNIV OH RESEARCH INST F/G 5/8
USER'S GUIDE FOR COMBIMAN PROGRAMS (COMPUTERIZED BIOMECHANICAL --ETC(U)
JAN 81 P BAPU, S EVANS, P KIKTA, M KORNA F33615-78-C-0507
UNCLASSIFIED UDR-TR-80-44 AFAMRL-TR-80-91 NL

4 of 4
AD A097705

END
DATE FILMED
5-81
DTIC

```
FCTHRTLM      0  00  1593  1266   857
FIAOAI        0  00  2449   543  2802
FIHUD         0  00  2799    0.  2779
FISTBYCD      0  00  3183 -1575  1618
FWDPTLTD      0  00  4059  3500  2275
FWDPTRTD      0  00  4059 -3500  3475
IMPCSSRC      0  00  4869     0   -90
LONGLT        0  00   611  1542  1264
MAP CASE      0  00  -890 -1810   684
MSCANREL      0  00  1111 -1442   904
NUTRLSRP      0  00     1     0     0
RUDPDLAB      0  00  2869   725  -456
RUDPDLAN      0  00  3119   725  -506
RUDPDLAT      0  00  3369   725  -456
RUDPDLFB      0  00  3669   725  -506
RUDPDLFN      0  00  3919   725  -556
RUDPDLFT      0  00  4209   725  -506
RUDPDRAB      0  00  2869  -725  -456
RUDPDRAN      0  00  3119  -725  -506
RUDPDRAT      0  00  3369  -725  -456
RUDPDRFB      0  00  3669  -725  -506
RUDPDRFN      0  00  3919  -725  -556
RUDPDRFT      0  00  4169  -725  -506
SNDSEATE      0  00    -6     0   -71
SRP DOWN      0  00    59     0  -190
SRP UP        0  00   -90     0   287
STDPOSLH      0  00 27059     0 -9913
STDPOSRH      0  00 27059     0 -9913
STDPOSLF      0  00 27059     0 -9913
STDPOSRF      0  00 27059     0 -9913
STDPOSEY      0  00 27059     0 -9913
WSARMREL      0  00  2908     0   389
WSBPC         0  00  2259  1350   475
$ACC A7—SEAT    5   1   0.0   0.0   0.0 F L U
001SBTP          14  -435  -750  2359     1  -750     0     1   750     0
  -440   750   2363
002BKHDRST       14  -495  -350  3535  -350  -650  2655  -350   650  2655
  -495   350   3535
003SPANMID       14    00  -750    00    00   750    00  1279   750   125
  1279  -750    125
004SPANFWDL      14  1277   225   131  1277   750   131  1720   750   212
  1719   228    215
005SPANFWDR      14  1277  -225   131  1277  -750   131  1720  -750   212
  1719  -228    215
DESEYE           00   0.0   0.0   0.0
$END
/*
//                                                               00110000
```

APPENDIX F

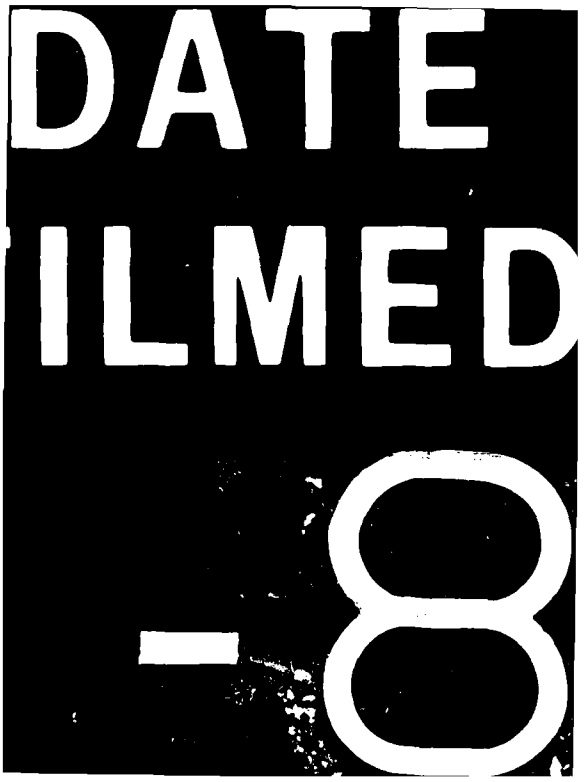
THE JCL AND DATA REQUIRED TO CREATE THE COMBIMAN VISIBILITY DATA BASE MEMBER A7E-01

```
//CBMVM    JOB HESS                                                    00001000
//JOBLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR                            00001100
//CBMVM    EXEC PGM=CBMVM                                              00001200
//FT05F001 DD DDNAME=SYSIN                                             00001300
//FT06F001 DD SYSOUT=A                                                 00001400
//FT07F001 DD SYSOUT=B                                                 00001500
//FT09F001 DD DSN=COMBIMAN.VISDATA,UNIT=DISK,DISP=(NEW,CATLG),        00001600
//            VOL=SER=DISK01,SPACE=(240,200),                          00001610
//            DCB=(BLKSIZE=240,LRECL=240,RECFM=FB)                     00001620
//SYSUDUMP DD SYSOUT=A                                                 00001730
//SYSIN    DD *                                                        00001800
$INT
$ACD A7E-01    2 270.6   0.0 99.15 A R L FS BL nL
001WINDSCREEN, FRONT TOP      32
 22763  -564 12535
 22379  -551 12324                                                          104
 22098  -546 12157                                                          104
 21893  -519 12059                                                          104
 21579  -467 11876                                                          104
 21314  -427 11735                                                          103
 21109  -362 11616                                                          103
 20914  -281 11584                                                          103
 20914   000 11584                                                          103
 20914   281 11584                                                          102
 21109   362 11616                                                          102
 21314   427 11735                                                          102
 21579   486 11876                                                          102
 21893   519 12059                                                          101
 22098   546 12157                                                          101
 22379   551 12324                                                          101
 22763   564 12535
 23000   578 12665                                                          201
 23212   568 12784                                                          201
 23444   541 12903                                                          201
 23731   470 13059                                                          202
 23941   405 13173                                                          203
 24109   292 13286                                                          203
 24212   200 13341                                                          204
 24212   000 13341                                                          205
 24212  -200 13341                                                          205
 24109  -292 13286                                                          205
 23941  -405 13173                                                          205
 23731  -470 13059                                                          204
 23444  -541 12901                                                          204
 23212  -568 12784                                                          204
 23000  -578 12665
002COCKPIT CANOPY CLEARLINE 1 92
 29447   000 13550
 29404   247 13460                                                          301
 29361   622 13326                                                          301
 29322   832 13201                                                          301
 29261  1054 13024                                                          302
 29209  1243 12860                                                          302
 29162  1378 12700                                                          302
 29114  1503 12557                                                          302
 29067  1589 12415                                                          303
 29002  1730 12238                                                          303
 28959  1805 12086                                                          303
 28907  1886 11944                                                          303
```

28855	1951	11832	304
28795	1946	11771	304
28743	1946	11732	304
28678	1941	11698	304
28596	1930	11676	305
28471	1930	11659	305
28281	1914	11641	305
28134	1908	11629	305
27987	1897	11616	306
27767	1886	11594	306
27572	1865	11577	306
27335	1849	11555	306
27080	1838	11533	307
26894	1882	11516	
26713	1800	11499	307
26497	1789	11486	307
26073	1751	11442	308
25853	1724	11425	308
25559	1703	11430	308
25469	1697	11460	309
25292	1578	11577	
25192	1470	11745	309
25132	1389	11857	310
25067	1335	11970	310
25067	1335	11970	310
24955	1178	12238	310
24907	1097	12430	311
24873	1016	12550	
24821	881	12700	311
24782	784	12850	311
24743	632	13000	312
24708	497	13200	
24678	281	13450	312
24661	000	13500	312
24678	-281	13450	313
24708	-497	13200	313
24743	-632	13000	313
24782	-784	12850	313
24821	-881	12700	314
24873	-1016	12550	314
24907	-1097	12430	314
24955	-1178	12238	314
25067	-1335	11970	315
25132	-1389	11857	315
25192	-1470	11745	315
25291	-1578	11577	316
25469	-1697	11460	316
25559	-1703	11430	316
25711	-1719	11413	317
25853	-1724	11425	317
26073	-1751	11443	317
26272	-1773	11464	317
26477	-1789	11486	318
26713	-1800	11499	318
26894	-1822	11516	318
27080	-1838	11533	318
27335	-1849	11555	319
27572	-1865	11577	319
27767	-1886	11594	319

```
 27987 -1897 11616                                                    319
 28134 -1908 11628                                                    320
 28281 -1914 11641                                                    320
 28471 -1930 11659                                                    320
 28596 -1930 11676                                                    320
 28678 -1941 11658                                                    321
 28743 -1946 11732                                                    321
 28795 -1946 11732                                                    321
 28855 -1951 11832                                                    321
 28907 -1886 11944                                                    322
 28959 -1805 12086                                                    322
 29002 -1730 12238                                                    322
 29067 -1589 12415                                                    322
 29114 -1503 12557                                                    323
 29162 -1378 12700                                                    323
 29209 -1243 12858                                                    323
 29261 -1054 13024                                                    323
 29322 - 832 13201                                                    324
 29361 - 622 13326                                                    324
 29404 - 247 13460                                                    324
 29447   000 13550
&END
/*
//                                                                    00001900
```


*U.S.Government Printing Office: 1981 — 757-002/450


DATE
ILMED
-8